THURSDAY, JULY 1, 1880

THE SACRED BOOKS OF THE EAST

The Sacred Books of the East. Edited by F. Max Müller. Vols. iv., v., and vii. (Clarendon Press, 1880.)

THE great work upon which Prof. Max Müller is engaged goes on apace. Volume after volume issues from the University Press containing the principal portions of the sacred literature of the East translated by competent scholars. The materials for a science of religion are being rapidly accumulated. The grand conception of a science which shall trace the development and relations of the religions of the world and determine the laws that have presided over their birth, their growth, and their decay is no longer a dream of the distant future. Before many years are over the materials will be in our hands for realising that conception, if indeed it is ever to be realised at all.

The fourth and fifth volumes of the series introduce us to Zoroastrianism, the great Puritan religion of the Aryans, and thus the counterpart of Mohammedanism in the Semitic world. The fourth volume contains M. Darmesteter's translation of the Vendîdâd, a compilation of religious laws and mythological tales which forms the first part of the Avesta or Zoroastrian bible. The two other parts consist of the Vispêrad or litanies for the sacrifice, and the Yasna, which includes five hymns or Gâthâs written in a peculiar dialect and constituting the oldest portion of the Avesta. Besides these the Parsis also reverence the Khorda Avesta or Small Avesta, comprising short prayers, the Yashts or hymns of praise, and several other fragments.

These are all that is left of a much larger body of sacred literature which once existed among the disciples of Zoroaster. According to Parsi tradition, out of the twenty-one Nosks or books revealed to the Mazdean prophet one only, the Vendîdâd, remains complete, and though this tradition cannot be accepted in its literal form, there is abundant evidence that the Parsis have saved only scattered fragments out of the wreck of their sacred books caused by Greeks, by Christians, and by Mohammedans. In their present shape, moreover, these fragments do not go back beyond the age of the Sassanians, indeed they bear traces of even later modernisation; but the basis upon which they rest, the leading ideas they embody, and numerous passages that are imbedded in them are of much earlier date. If we may trust Dr. Oppert's translation of the Protomedic transcript of the inscription of Darius Hystaspis at Behistun, it was that Persian monarch who ordered the Avesta or "law" and the Zend or "Commentary" to be restored after the religious disturbances of the Magian usurpation. At any rate there can be little doubt that both existed before the foundation of the Persian Empire.

But like all other religions, Mazdeism developed and became changed in the process of time, and this development and gradual change may be read in the records of its sacred books. M. Darmesteter points out the untenability of the view which made it at the outset a revolt against the old Vedic religion of the Eastern Aryans; on the contrary, it grew naturally out of the elements, religious and mythological, which we see reflected in the Rig-Veda of India, and even after taking shape and consistency, after the days of Darius and the Sassanians, it still continued to grow. In the hands of its priests it became more and more rigorous and ceremonial; ancient texts were misinterpreted, and the misinterpretation carried out to its logical consequences.

In the fifth volume Dr. West introduces us to a later phase of Zoroastrian belief. He translates for us the Pahlavi texts, the Bundehesh, the Zâd-sparam, the Bahman Yasht, and the Shâyast lâ-shâyast, which are translations and explanations of the older Avesta. The Zend language had become obsolete, and the books written in it accordingly required to be translated and interpreted. The Pahlavi texts have, therefore, preserved portions of the ancient Zoroastrian scriptures which would otherwise have been lost. The Pahlavi is the language of mediæval Persia, the daughter of the Persian of Darius and his successors, and the niece of the Zend dialect of the Avesta. Our acquaintance with it practically begins with the inscriptions of Artakhshîr-i Pâpakân (A.D. 226–240) the founder of the Sassanian dynasty, and ends with Parsi writings, one of the latest of which is dated A.D. 881. The Pahlavi alphabet is an exceedingly difficult one; its letters have been corrupted to a prodigious extent, so that a large number of them are written exactly alike. The difficulties in the way of reading it may therefore be imagined. Pahlavi texts, however, are not always written in the Pahlavi alphabet; sometimes the Zend alphabet of the Avesta, sometimes the modern Persian alphabet, is used instead.

But the reading of these texts is further complicated by the introduction of Semitic words, which have, however, to be replaced in pronunciation by their Persian equivalents. Thus what is written *malkân malkâ*, "king of kings," would have to be pronounced *shâhân shâh*. The same phenomenon meets us in the cuneiform inscriptions, where an Accadian word often occurs in an Assyrian text, for which its Assyrian equivalent has to be substituted in reading, and so too in modern Japanese Chinese words are written but translated into Japanese by the reader. The usage of Pahlavi seems to be ancient, since the cuneiform alphabet of the Achæmenian inscriptions was obtained by Darius by translating a certain number of Assyrian ideographs into Persian and then setting apart the initial sound of the Persian word as the alphabetic value of the ideographic character. In addition to these Semitic logograms the Parsis also gave a conventional pronunciation to certain obsolete Persian words, the true pronunciation of which they had forgotten and were unable to recover owing to the obscurities of Pahlavi writing, and the employment of these two kinds of logograms is termed Huzvâresh.

The seventh volume contains a translation by Prof. Jolly of the Vishnu-sûtra, a semi-inspired Hindu law-book belonging to one of the schools who studied the Black Yajur Veda, and closely related to the famous Code of Manu. It has been revised by a Vishnuitic editor of comparatively recent date, but the substance of it goes back to an early time, before the introduction of *sati* or widow-burning, or even, it may be, the rise of Buddhism. It will be interesting to the lawyer as well as to the student of religion, who will be tempted to compare it with the book of Leviticus. Its minute and absurd

regulations as to ceremonial expiation and penance, its tyrannous assertion of Brahminical domination, and its unpractical and unspiritual character will illustrate the condition to which a religion may be brought by mere subtlety and barren meditation, divorced from active life and influenced by an interested priesthood.

A. H. SAYCE

EVOLUTION OF THE VEGETABLE KINGDOM

Versuch einer Entwicklungsgeschichte der Pflanzenwelt, insbesondere der Florengebiete seit der Tertiärperiode. Von Dr. Adolf. Engler. I. Theil. Die Extratropischen Gebiete der Nördlichen Hemisphäre. Mit einer chromolithographischen Karte. 8vo. pp. 202. (Leipzig: Verlag von Wilhelm Engelmann, 1879.) Essay of a History of the Evolution of the Vegetable Kingdom, especially of the Floral Areas since the Tertiary Period. Part I.—The Extratropical Regions of the Northern Hemisphere.

PHYTOGEOGRAPHY still presents many difficult problems, the final solution of some of which is extremely unlikely, though patient research will doubtless bring us much nearer the truth than we have yet reached. The latest comprehensive work on the subject (Grisebach's "Vegetation der Erde") is a very good exposition of the existing distribution of plants, but it is nothing more. Since the promulgation of the theory of descent, however, the study of the dispersion of plants has entered upon a fresh phase, and it has received the attention of some of the ablest minds engaged in botanical pursuits; and with the ever-increasing geological evidence of the composition of the floras of former periods there is a good prospect of a real advance in this branch of science. Unfortunately there is a tendency to travel far beyond a point warranted by the evidence. This remark specially applies to the determination of many of the fossils of the earliest Tertiary times. Whether fresh discoveries will prove the correctness or the incorrectness of Unger's "New Holland in Europe," we do not venture to predict, though we think the latter; but we agree with Saporta that most of the assumed determinations are better designated by such terms as affiliation and collocation (*assimilation et rapprochement*). Dr. Engler is not an unknown worker in phytogeography, for in his various monographs, especially in that of the genus *Saxifraga*, he has set forth the views which he, in some respects, more fully elaborates in the work before us. The essay itself is preceded by thirty-six formulated leading ideas (*leitende Ideen*), which may, for our purpose, be reduced to one, namely, the relation of evolution and geological changes to distribution. Dr. Engler endeavours to trace the descent and migration of the vegetation of the regions under consideration since the Tertiary period by the aid of geological and recent evidence, but for various reasons he does not go back beyond the Miocene period. In his conception of the Miocene period he is in accord with Prof. Heer, who, he thinks, has easily refuted the arguments adduced by Mr. Starkie Gardner in support of his opinion that much of what Prof. Heer regards as Miocene is referable to the Eocene period. The author divides his subject into five sections and eighteen chapters. In the first section he treats of the development of the flora of North America from the Miocene period to the Glacial epoch; the second is devoted to the development of the flora of Eastern and Central Asia since Tertiary times; the third to the main features of the development of the Mediterranean flora since the Tertiary period; the fourth to the development of the high mountain flora before, during, and after the Glacial epoch; and the fifth to the consideration of the development of the floras of other countries influenced by the Glacial period. The map is constructed to show, as nearly as possible, the configuration of land and water in Tertiary times, the direction of the spreading and change of the vegetation during and after the gradual drying-up of the Tertiary seas, and the most important migratory routes of the Glacial plants. Disregarding the evolutionary element, which must necessarily be to a large extent purely speculative, Dr. Engler's essay is exceedingly interesting and instructive. The mere collocation of the facts bearing upon the subject renders it so, independently of the author's deductions therefrom. So far as the migratory part is concerned, it may be designated as an amplification, with some modifications, of the theory recently discussed by Dr. Asa Gray, Sir Joseph Hooker, Mr. Thiselton Dyer, and others. Dr. Engler does not find the contrast so great in the development of the Asiatic element in the vegetation of Eastern and Western North America, and there is no doubt of the existence of many more Asiatic types in Western North America than was formerly suspected. Diligent as the author has been in collecting evidence, he has overlooked some that he would have found useful. Thus at page 29 he seeks to explain the "extraordinarily interrupted distribution" of *Monotropa uniflora* and *Phryma leptostachya*, both of which he assumes to be limited to the Himalayas, North-eastern Asia, and Eastern North America. Now *Monotropa uniflora* is common in North America west of the Rocky Mountains, as evidenced by specimens and collectors' notes in the Kew Herbarium; and it likewise occurs in Mexico, New Granada, Sachalin, and the Corea. The distribution of *Phryma*, too, is by no means so restricted as Dr. Engler supposes. But these are minor details which do not affect the main issues.

Although evolution is the pervading feature of the work, the author nowhere attempts to point out the original types from which other species have descended, as he does in his monograph of the genus *Saxifraga*. Bunge, who devoted much time to the study of large genera, constructed a genealogical tree to illustrate the possible descent of the species of *Acantholimon*, but he admits that the result was eminently unsatisfactory. If so difficult to trace the descent of a genus having the distribution of *Acantholimon*, we may excuse Dr. Engler for being less successful on the evolution theme than he is on migration.

W. B. HEMSLEY

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to ensure the appearance even of communications containing interesting and novel facts.*]

The Freshwater Medusa

I OBSERVE in Prof. Allman's article of last week (p. 178) on this organism, that he states that the article in question includes

"additional facts not contained in the paper" read by him to the Linnean Society.

Although Prof. Allman does not directly allude to my article of the week before (p. 147), I may assume that the statements which he makes in opposition to my conclusion that Limnocodium (Craspedacustes) belongs to the group of the Trachomedusæ were elicited by the publication of my results.

I intend in the July number of the *Quarterly Journal of Microscopical Science* to show in an illustrated memoir that, contrary to the conclusion of Prof. Allman, the tentacles of Limnocodium do resemble those of the Trachyline Medusæ in their insertion and in the possession of true (though rudimentary) peronia, as I stated in my original note and in my paper read to the Royal Society on June 17. I shall also show that my statement that the so-called lithocysts or marginal bodies have essentially the same structure as those of Trachyline Medusæ (being modified tentacles with an endodermal axis) is warranted by the developmental history of the bodies in question. Consequently I adhere to my original determination of the affinities of the new Medusa as one of the order Trachomedusæ, and cannot agree with Prof. Allman that its affinity with the Leptomedusæ must be regarded as the closer of the two.

Prof. Allman states that he has arranged certain methods of observation with Mr. Sowerby, by which he hopes to determine the developmental history of Limnocodium. It will be of the greatest interest to have this matter fully investigated, and to know what are the methods which Prof. Allman has devised to this end. Mr. Sowerby informs me that at present he has undertaken no experiments of the kind excepting the isolation of specimens in two glass jars in the lily-house, which he carried out at my special request on June 15.

In the meantime I may say that I have fully satisfied myself that Limnocodium develops directly from the egg. When specimens are kept living in a glass jar under constant observation it is found that exceedingly small specimens of the Medusa make their appearance amongst the larger specimens. Mr. Sowerby had already determined this fact a fortnight ago, when I first was introduced by him to the Medusa. I have now, through his kindness, been able to examine several young phases of Limnocodium, the discovery of which is entirely due to him.

The youngest specimen which I have seen at present measured only the one-thirtieth of an inch in diameter, and I have had others under observation very little larger. The smallest was of a sub-spherical form without any aperture to the ectodermal investment. Four minute tentacles were sprouting near one pole of the spherical body, and between these rudiments of four others were seen. Within—the subumbrellar musculature was already developed and contracting at intervals. The four radial canals were also present, and, what is more remarkable, the sub-umbrellar cavity was already well marked, and within it the manubrium with the oral aperture. Yet the margin of the umbrella was still closed by a continuous ectodermal coat which, when perforated, would, I conceive, become the velum.

These minute embryos correspond very closely in appearance with the embryos of the well-known typical Trachomedusan Geryonia, as figured by Metschnikow in the *Zeitsch. für wiss. Zoologie*, vol. xxiv., Plate II., Figs. 12 and 15.

They leave no possibility of supposing that Limnocodium has, like most Leptomedusæ, a hydroid trophosome. In respect of its development as in other respects, Limnocodium is not more closely allied to the Leptomedusæ than to the Trachomedusæ, but is one of the Trachomedusæ.

A remarkable fact which I am not able to explain is the excessive rarity of females amongst the specimens of Limnocodium taken from the tank in Regent's Park. All the specimens which I have examined have been males. Females clearly enough must be present, or have been present amongst the shoals of males—whence the embryos discovered by Mr. Sowerby.

It is a known fact among Trachyline Medusæ that in some species males are excessively abundant, and even in some species females have never been detected. Thus again Limnocodium agrees with the Trachyline Medusæ.

One word more with regard to the name of the new Medusa. Whilst I waive the right of priority for the generic term Craspedacustes, and adopt Prof. Allman's term Limnocodium, I feel it to be only right to maintain the association of Mr. Sowerby's name with this discovery, which I had originally proposed, and I shall accordingly henceforth speak of the Medusa as *Limnocodium Sowerbii*, Allman and Lankester.

E. RAY LANKESTER

Aqueous Vapour in Relation to Perpetual Snow

SOME twelve years ago I gave (*Phil. Mag.*, March, 1867, "Climate and Time," p. 548) what appears to be the true explanation of that apparently paradoxical fact observed by Mr. Glaisher, that the difference of reading between a thermometer exposed to direct sunshine and one shaded *diminishes*, instead of increases, as we ascend in the atmosphere. This led me to an important conclusion in regard to the influence of aqueous vapour on the melting-point of snow; but recent objections to some of my views convince me that I have not given to that conclusion the prominence it deserves. I shall now state in a few words the conclusion to which I refer.

The reason why snow at great elevations does not melt but remains permanent, is owing to the fact that the heat received from the sun is thrown off into stellar space so rapidly by radiation and reflection that the sun fails to raise the temperature of the snow to the melting-point; the snow evaporates, but it does not melt. The summits of the Himalayas, for example, must receive more than ten times the amount of heat necessary to melt all the snow that falls on them, notwithstanding which the snow is not melted. And in spite of the strength of the sun and the dryness of the air at those altitudes, evaporation is insufficient to remove the snow. At low elevations, where the snowfall is probably greater and the amount of heat even less than at the summits, the snow melts and disappears. This, I believe, we must attribute to the influence of aqueous vapour. At high elevations the air is dry and allows the heat radiated from the snow to pass into space, but at low elevations a very considerable amount of the heat radiated from the snow is absorbed in passing through the atmosphere. A considerable portion of the heat thus absorbed by the vapour is radiated back on the snow, but the heat thus radiated, being of the same quality as that which the snow itself radiates, is on this account absorbed by the snow. Little or none of it is reflected like that received from the sun. The consequence is that the heat thus absorbed accumulates in the snow till melting takes place. Were the amount of aqueous vapour possessed by the atmosphere sufficiently diminished, perpetual snow would cover our globe down to the sea-shore. It is true that the air is warmer at the lower level than at the higher level, and by contact with the snow must tend to melt it more at the former than at the latter position. But we must remember that the air is warmer mainly in consequence of the influence of aqueous vapour, and that were the quantity of vapour reduced to the amount in question the difference of temperature at the two positions would not be great.

But it may be urged, as a further objection to the foregoing conclusion, that as a matter of fact on great mountain chains the snow-line reaches to a lower level on the side where the air is moist than on the opposite side where it is dry and arid. As, for example, on the southern side of the Himalayas and on the eastern side of the Andes, where the snow-line descends some 2,000 or 3,000 feet below that of the opposite or dry side. But this is owing to the fact that it is on the moist side that by far the greatest amount of snow is precipitated. The moist winds of the south-west monsoon deposit their snow almost wholly on the southern side of the Himalayas, and the south-east trades the snow on the east side of the Andes. Were the conditions in every respect the same on both sides of these mountain ranges, with the exception only that the air on one side was perfectly dry, allowing radiation from the snow to pass without interruption into stellar space, while on the other side the air was moist and full of aqueous vapour absorbing the heat radiated from the snow, the snow-line would in this case undoubtedly descend to a lower level on the dry than on the moist side. No doubt more snow would be evaporated off the dry than off the moist side, but melting would certainly take place at a greater elevation on the moist than on the dry side, and this is what would mainly determine the position of the snow-line.

In like manner the dryness of the air will in a great measure account for the present accumulation of snow and ice on Greenland and on the Antarctic continent. I have shown on former occasions that those regions are completely covered with perpetual snow and ice, not because the quantity of snow falling on them is great, but because the quantity melted is small. And the reason why the snow does not melt is not because the amount of heat received during the year is not equivalent to the work of melting the ice, but, mainly because of the dryness of the air, the snow is prevented from rising to the melting-point.

There is little doubt but that the cold of the glacial epoch would produce an analogous effect on temperate regions to that

experienced at present on Arctic and Antarctic regions. The cold, although it might to some extent diminish the snowfall, would dry the air and prevent the temperature of the snow rising to the melting-point. It would not prevent evaporation taking place over the ocean by the sun's heat, but the reverse, but it would prevent the melting of the snow on the land during the greater part of the year.

In places like Fuego and S. Georgia, where the snow-fall is considerable, perennial snow and ice are produced by diametrically opposite means, as I have elsewhere shown, viz., by the sun's heat being cut off by clouds and dense fogs. In the first place the upper surface of the clouds act as reflectors, throwing back the sun's rays into stellar space; and in the second place, of the heat which the clouds and fogs absorb, more than one-half is not radiated downwards on the snow, but upwards into space. And the comparatively small portion of heat which manages to reach the ground and be available in melting the snow is insufficient to clear off the winter's accumulation.

JAMES CROLL

Artificial Diamonds

ON reading Mr. Hannay's communication to the Royal Society on the production artificially of crystallised carbon or diamond (*Proc.* Roy. Soc., vol. xxx., No. 204, May, 1880), in the course of which Mr. Hannay states that he has made eighty experiments, only three of which have been successful. In almost every case his iron or steel vessels, enormously thick in proportion to their small bore, have burst at a red heat or above it, by the pressure of the included hydrocarbon vapour.

Will Mr. Hannay permit me to suggest to him that if, instead of an enormously thick and difficult to weld up tube, he will inclose his materials in a comparatively thin one and then inclose that in another like tube shrunk on or contracted over the former, and so on to a third, or, if necessary, fourth tube, each possessing an initial tension upon those within it, he may thus obtain compound tubes either of wrought iron or steel easily welded staunch, and capable of withstanding any assignable amount of internal elastic pressure. This is the principle upon which, since 1855, all rifled artillery is constructed.

The Grove, Clapham Road, June 22 R. MALLET

A Fourth State of Matter

IN Mr. Crookes' communication on this subject (NATURE, vol. xxii. p. 153) occurs the sentence, "An isolated molecule is an inconceivable entity." This proposition would appear to me to be questionable. For if we cannot conceive an isolated molecule, how are we to conceive of two (or more) molecules, *i.e.*, conceive of matter at all? For the conception of two molecules involves the isolation of each in the mind, otherwise surely the two would be mentally blended into one. It is further said of a molecule, "Solid it cannot be." May not the external qualities ordinarily attributed to a "solid" be said to be those of a body possessing a certain amount of rigidity (*i.e.*, whose parts resist displacement) combined with a certain elasticity? Would not these be substantially the properties of a single vortex molecule, according to those who have investigated this subject? For it appears that such a molecule would be (perfectly) elastic, and inseparable into parts. At the same time it would seem that there would be nothing to prevent it from being harder or more rigid than any large scale solid (built up of such molecules?) with which we are acquainted.

"A fourth state of matter," as it appears to me, is a distinction which has something arbitrary about it. If (for instance) the æther be a gas, the mean length of path of whose minute molecules is not less than planetary distances—a proposition which it might not be easy to disprove directly—then this would be a mean path indefinitely greater than that of the molecules of the most rarefied gas. Would it, however, be legitimate to regard the æther (under this condition) as matter in "a fourth state"? This would seem, in my judgment at least, only to complicate the subject unnecessarily. For after all we are concerned in such cases with the mere quantitative difference of length of path. S. TOLVER PRESTON

London, June 28

Auroral Observations

IN order to get nearer, if possible, to the unravelling of the mysteries of the aurora borealis, I have in the course of the last two years endeavoured to procure a great number of observations of this phenomenon in Norway, Sweden, and Denmark. I have succeeded in engaging throughout the above-named countries several hundreds of observers, who, led only by scientific interest, have lent me their assistance, and from whom I have already received a considerable amount of information. These observations are to be continued, as there is reason to suppose that the aurora borealis in the near future will appear much more frequently than has been the case during the last years. Finland and Iceland will also now be drawn within the circle, and *it would be most desirable that similar observations were made also in Great Britain*, which country—especially in the maximum years of the appearance of the aurora borealis—certainly would yield characteristic contributions in this respect. I therefore take the liberty to invite friends of science to make such observations in accordance with the system which I have introduced in Scandinavia; a schedule for recording observations, along with the necessary instructions, will be sent to any one who, before the end of August, informs me of his name and address.

SOPHUS TROMHOLT

Bergen, Norway, June Professor of Mathematics

Other papers in Great Britain are requested kindly to give the above appeal a place in their columns.

The Hydrographic Department

As you have been misinformed on several points respecting my connection with the Hydrographic Department, I request, both on public grounds and in ordinary fairness to myself, that you will insert the following corrections of statements in your article on this subject in NATURE, vol. xxii. p. 86.

My work on the Norwegian coast has not been "dignified into a hydrographical survey." That work, combined with my knowledge of the Norwegian language, charts, and pilotage, satisfied the hydrographer that I was competent to compile a "Norway Pilot." It is incorrect to represent that I have ever laid claim to anything more than that.

I have not made a "rude" or "ungenerous" attack on the Hydrographic Department. I have temperately stated facts which cannot be disproved, in the interests of hydrography, and to show the necessity for giving increased strength and efficiency to the department. It is no answer to these facts to disparage my own efforts in the cause, or to call me a small and obscure clique actuated by personal motives. The clique to which I belong is small indeed, for it consists only of myself. It may also be obscure, but it is untrue that I am influenced, in anything I may do, by other than public motives and a desire to further the interests of commerce and of hydrography.

The gravest error into which your informant has led you is the statement that the Hydrographic Department had confided to me, "mistakenly" or otherwise, the "*revision* of the sailing directions" for part of Norway. I *compiled* those sailing directions, as expressly stated in the official printed "Advertisement," signed by the hydrographer himself, and the department has done exactly the opposite of what your informant states; it has refused to allow me to *revise* my own work, and has consequently published an erroneous light list, which will be followed by an incomplete "Pilot." Against this procedure it is my obvious duty to protest. I am also bound to warn all those whom it may concern of the errors to which the department has deliberately given dangerous publicity.

The paper read before the Society of Arts brought the dangers along the trade route between England and Siberia to public notice in some detail, and contained other facts relating to neglected surveys and to charts compiled from antique and inadequate data, which it was right that merchants and seamen should be aware of. If my statements are accurate—and I challenge your informant to disprove any one of them—then the Society of Arts did useful service in accepting my paper. No good end can be gained by calling me names and accusing me of personal motives. Let my statements be disproved if your informant is able to disprove them. If he cannot do so, then those statements are incontrovertible witnesses to the fact that the Hydrographic Department is unequal to the demands upon it. Unsupported assertions that the department stands "well, and deservedly so, in the estimation of scientific circles," are of no weight when opposed to facts, which your informant cannot disprove, and apparently dares not face. GEORGE T. TEMPLE

The Nash, near Worcester, June 2

[WE have given publicity to Lieut. Temple's reply to the

notice on the Hydrographic Department which appeared in NATURE, vol. xxii. p. 86, on the grounds advanced by him in the first paragraph of his letter.

Our readers will scarcely receive Lieut. Temple's statement that that department has deliberately given dangerous publicity to errors. This would be contrary to the traditions, and certainly to the interests, of any public office connected with the practical and working world. But however this may be, is not the Hydrographic Department pursuing a prudent course in causing a revision to be made of Lieut. Temple's compilation by another authority? In the interests of navigation we think it is; for on a great stretch of coast like Norway, which, from its sinuous and broken character, can be reckoned by thousands of miles of sea-board, it is clearly unadvisable that dependence should be entirely placed on the efforts of one individual.

We are the more confirmed in this belief from a significant letter which lately appeared in the *Shipping and Mercantile Gazette* and in the *Daily News* from the Royal Norwegian Geographical Survey Office, dated Christiania, the 16th inst., written, as the writer alleges, "in order to correct the erroneous statements contained in Mr. Temple's paper (read at the Society of Arts) respecting the charts and descriptions of the Norwegian coast now existing."—ED.]

Curious Electric-Phenomenon

AT about 4.30 p.m. this day a severe thunderstorm with a deluge of rain came up from the north-west and lasted about an hour. At 5.30 my wife was standing at the window watching the receding storm, which still raged in the south, just over Leicester, when she observed, immediately after a double flash of lightning, what seemed like a falling star, or a fireball from a rocket, drop out of the black cloud about 25° above the horizon, and descend perpendicularly till lost behind a belt of trees. The same phenomenon was repeated at least a dozen times in about fifteen minutes, the lightning flashes following each other very rapidly and the thunder consisting of short and sharp reports. After nearly every flash a fireball descended. These balls appeared to be about one-fifth or one-sixth the diameter of the full moon, blunt and rounded at the bottom, drawn out into a tail above, and leaving a train of light behind them. Their colour was mostly whitish, but one was distinctly pink, and the course of one was sharply zig-zagged. They fell at a rate certainly not greater than that of an ordinary shooting star. I have never witnessed a phenomenon of this kind myself, but my wife is a good observer, and I can vouch for the trustworthiness of her report. F. T. MOTT

Birstal Hill, near Leicester, June 22

Meteor

ON Friday, June 11, at 8.5 p.m., while the sun was still shining, I saw due east as near as I could judge, and about 30° above the horizon, a bright white meteor pass across about 10° or 12° from right to left with a slight downward course. Two or three hours later I saw a small one take a parallel course, but the other side the zenith. W. ODELL

Coventry, June 14

Minerva Ornaments

DURING a recent visit to England I spent a considerable time in the Museum at South Kensington, and Dr. Schliemann's collection of antiquities was one of the objects in that museum which I was most desirous to see.

I should like to call attention to one point in regard to this collection of relics. Among others I saw a number of flat rounded pebbles, which, by chipping at the middle on both edges, have been brought into something like the shape of an hour-glass. These are marked "Minerva Ornaments." There are several other relics, the titles on which seemed to me to be, speaking within bounds, somewhat imaginative; such, for example, as the small pieces of gold plate on the πλεκτὴ διαδέσμη, or headdress, where Dr. Schliemann sees the owl's head and two large eyes, "which cannot be mistaken"; but to name these flat pebbles "Minerva Ornaments" seems to trespass not a little beyond the due limits of the imagination when applied to science.

Stones of precisely the same shape and size, and cut in the same way, are common in this country, where Minerva was "an unknown goddess" before the arrival of the Christians. They are picked up on the banks of the rivers, and when placed in collections are ticketed "net-sinkers." I cannot doubt that Dr. Schliemann's "Minerva Ornaments" are only Trojan net-sinkers formed as those of the aboriginal inhabitants of this country, because the savage mind seems to have run in the same channel all over the world. E. W. CLAYPOLE

Antioch College, Ohio

A Snake in Kensington Gardens

I WAS considerably surprised this evening at finding the lifeless body of a snake about one hundred yards to the south-east of Kensington Palace. A policeman informed me that he had killed it there last Thursday as it was rapidly moving over the ground. The head and neck had been utterly destroyed, most likely by stampings of the policeman's foot, but the remainder of the body was perfect. In length it was about twenty inches, the body, from the thickness of a little finger, gently tapering to a tail ending in a fine point. Regular scales, brownish-black in colour, clothed the back, the scales along the sides being yellowish-green. A distinct fringe, or prolonged fin, stiffly standing erect, of about one-quarter of an inch in height, ran down the centre of the back, in colour the same as the rest of the body in that region. I trust this description may enable some of your readers learned in snakes to identify the species. Then I would ask, Is this animal a native of these parts, or had it been introduced, or had this specimen most likely escaped from captivity to meet with its untimely end? J. HARRIS STONE

11, Sheffield Gardens, Kensington, W.

THREE YEARS' EXPERIMENTING IN MENSURATIONAL SPECTROSCOPY

BY A NEW HAND THEREAT

IT was in 1876 that the experimenter,[1] of whom the following notes have been requested, clearly perceiving that it would not do any longer, even in his private work, to be content with merely a little direct-vision, ready-made, purchased, spectroscope and the few scale points offered by reference to lamp-flame lines—set about making up a tolerably large spectroscopic instrument to satisfy his own ideas, wants, and aims.

Now the leading desire with him herein, was, in suitable return for H.M. Government having then recently changed the locality of his official residence from a low, sunk position, where and whence little but other houses could be seen, to an elevated site half-way up the northern side of the Calton Hill, commanding an excellent view of the northern, north-eastern, and north-western horizons, together with the best and brightest parts of almost all auroral displays, whenever they occurred—it was his desire, as a decorous and appropriate tribute, to render some respectable spectroscopic account (over and above anything that the Royal Observatory, Edinburgh, and its more purely astronomical instruments could do) of those sometimes nocturnally luminous, but generally fitful, evanescent, and not yet fully explained, phenomena of the skies, the *Auroræ Polares*.

To this end the nascent spectroscope, mounted before a window in an upper chamber, assumed the form of a large flat telescopic box, almost five feet long, two broad, half a foot deep, supported on a stout alt-azimuth stand, with powerful screw motions. The box carried a gathering telescope in front, whose objective, as well as those of the internal collimator and inspecting telescope, were, like those of a "night-glass," large, *i.e.*, 2·2 inches in diameter; and short, *i.e.*, 17 inches, in focal length. An extensive and easily read scale for any prism's minimum deviation positions, and a long, but very easily worked, micrometer-screw motion for the telescope eye-piece were supplied, also an illuminated pointer. An electric reference spectrum of hydrogen lines above and below the fiducial central zone of the field of view was caused to be ever

[1] Prof. Piazzi Smyth, Astronomer-Royal for Scotland.

available; the slit, though 4 feet distant, was made capable of being adjusted from the observer's chair; a variety of prisms both simple and compound, with deviations from 0° to 45°, and dispersions from 0°·5 to 14° between A and H solar, but all of large size, and capable of being used in quick succession at pleasure, were added; with further arrangements for bringing into central view and correct measure, many other natural spectroscopic milestone lines, both with blowpipe-flame and induction-spark.

Thus far the instrument had been constructed, step by step to a series of orders, chiefly by M. Salleron, of 24, Rue Pavée au Marais, Paris, and it was ready in the beginning of 1877 for any aurora that should display itself in the north-north-western parts of the sky; but no auroras came, nor have any appeared up to the present time, February, 1880. But the instrument has not been idle. Its general material, wood, allowed it to be cut into and altered for any experiment, educational or otherwise; Mr. Adam Hilger, of 192, Tottenham Court Road, furnished it with a train of compound prisms raising its dispersion powers to 33° A to H, with improved Huyghenian rock-crystal eye-pieces and a spectrum-illuminated pointer of a remarkable kind for the purity of the colours successively imparted; until, though large parts of the apparatus were still rough, it had become, on the whole, an essentially *safe* instrument for spectroscoping numerically anything within its powers to spectroscope at all, and for looking into any such subject in a variety of different ways, and to different degrees as to definition, illumination, dispersion, and magnifying; thereby imparting considerable confidence in its final results: and this is the chief reason for saying so much at starting on the mere means employed.

Colours and Absorption Spectra.—The first series of observations with this new instrument was of a very simple kind as to the smallness of dispersion employed, and on an often discussed subject, viz., the colours both of the spectrum and of various coloured media, solid as well as fluid. These observations were printed by the Royal Society, Edinburgh, in vol. xxviii. of their *Transactions* (1878), in a paper extending through sixty-four pages and illustrated with three plates; one of them containing twenty-five different colours, viewed under seven different gradations. Though much of the subject matter of this paper could only be a confirmation, perhaps strengthening, of many previous workings by others in the same directions; yet the following points, more or less new, were also clearly established; as—

1. Colour bands, and bounding edges of coloured regions in the spectrum, are not fixed in spectral place as both Fraunhofer lines and luminous lines of gases so eminently are, but have a positive power of locomotion, within certain limits, according to intensity of illumination and depth of colouring matter. Witness especially the march of the whole red band of light, with successively increased depths of solution, over, and past, the black Fraunhofer line, both found on this occasion in oxalate of chromium and potash dissolved in water, and proved to be as fixed as any other Fraunhofer line in all spectroscopy.

2. Amongst colours the same to the eye, a physical difference still more important than colour was ascertained to exist, accordingly as their transmitted spectra formed, either one central beam, or two widely separated beams in spectral place. So that one *green* glass exhibited only the green region of the spectrum; while another glass, of different chemical coloration, but equally *green* to the eye, shone chiefly in setting forth the *ultra-red* regions of the spectrum at one end, and some of the blue at the other, but extinguished strangely the yellow, citron, green, and all that might have been expected *a priori* to have been well rendered by it.

3. Amongst these double-beam colours, of which cobalt-blue glass is an old example, well known from the times of Sir David Brewster downwards, a far more powerful case was met with in Judson's green dye of the aniline series; and by merely looking through a film of that (without any prismatic or spectroscopic assistance) it was shown to be possible to detect copper and arsenic greens among vegetable green dyes in papers and muslins; with all the facility too, of seeing the former become blue or black, while the latter became red, and sometimes gloriously so.

4. While the green of vegetation was in every case, both abroad and at home, together with its yellows, its blue as in litmus dye, and some of its browns, turned into crimson or scarlet—the green of shallow sea-water, as in the mouth of the Tagus, and the deep blue of the ocean, as in the Bay of Biscay, were both of them totally unaffected; but brown oars dipped in the act of rowing into the former, in itself unimpressible, green water, came up blood-red at every stroke; and brown seaweed floating in the blue Bay, appeared of a richer scarlet than any coral. These scenes too were all the more brilliant and life-like to the observer, though looking through something like a black ink-bottle, from the tendency ascertained of two superposed films of any of these double-beam colours, when *differently* illuminated (the one looked *at* having to be more strongly illuminated than the one looked *through*), to produce light, rather than double dark, in and about the F region of the spectrum; thus recalling a remarkable feature established by the late esteemed Prof. Clerk Maxwell, in his researches on colour-blindness.

Rain-band Spectroscopy.—The next subject on which the experimenter published (both in the *Journal* of the Meteorological Society of Scotland and in the fourteenth volume of the "Edinburgh Astronomical Observations") was the power of the spectroscope to foretell rain. This subject had been much studied by him already in various countries and climates with pocket spectroscopes, but assumed a far firmer character when their indications could be tested by the spectroscopic machine above described.

Every spectroscopist knows how rich in black lines and grey bands is the red-end of the spectrum of the sky; especially towards sunset, and near the horizon. M. Ångström had moreover already taught that some of those lines or bands were due to watery vapour, and others to dry gas, in the earth's atmosphere; while M. Janssen had minutely identified the components of the former as being of such an origin, by comparing them with the absorption lines in a long tube of high-pressure steam. The Edinburgh experimenter therefore started with much prepared to his hand, when seeking to obtain a practical use for meteorology out of such observations; and his further steps were these:—

1. He ascertained by many months of continued daily experience that the lines attributed to watery vapour in the spectrum of the sky, though formed by that vapour when in the state of a transparent, invisible gas, increased in their intensity of darkness, other things being the same, according to the quantity of such vapour present in the atmosphere. That quantity being independently ascertained for the time by reference to wet and dry bulb thermometers and the usual hygrometrical calculations.

2. To keep those "other things the same," and prevent the variations they are only too capable of setting up, from interfering with the one phenomenon now sought after, the experimenter confined his spectroscopic notings of the sky's light to a constant, and that a low, altitude therein; as well as to an hour giving a constant, and not a very low altitude to the sun, and an azimuthal direction considerably distant therefrom. Also to blue sky itself, as seen through openings between clouds, if possible, rather than to any cloud surface, and much rather than to

any haze, fog, or smoke surface nearer still than the clouds.

3. These precautions being taken, there was no difficulty in recognising, *first*, during frosty weather, when meteorologists know there is a minimum of moisture in the air, what should be the normal appearance of the dry-gas lines or bands, for they only are then conspicuous, and are chiefly great B, the *alpha* band between C and D, and a remarkable band on the green side of the universally known D line of the regular solar spectrum. That band being remarkable, not only for being situated as a dark shade in the otherwise brightest part of the spectrum of daylight, but by being much more dependent than the other dry bands, on the lowness of altitude of the sun at the moment, for its full and darkest development, and thence called in these inquiries "the low-sun band." *Next*, in the summer season of the year when the temperature has risen say to 70°, and we know, as *per* the acknowledged hygrometrical tables, that there is then four times as much, to the eye invisible, moisture in the air, for that reason only, as at 30° temperature—spectroscopic observation will show, simultaneously with and in addition to, all the previous dry-gas lines, not only a strong water-gas, or vapour, line closely following C, a true sun-line, but a much grander line, double line, or rather band of lines immediately preceding the solar line D; and this particular water-vapour group is in practice the only one of that kind which meteorologists need attend to in their ordinary daily work.

So far indeed we have only got, by its means, a species of thermometer; but if we go on observing day after day in nearly similar summer temperature, and accustom ourselves thereby to the then quality of appearance of that band preceding D—and if on the next day, at the same, or nearly the same, temperature, we should see the band, say twice as dark as on the previous days—then in that excess of darkness it has become "the rain band" sought for. Because that abnormal excess of darkness shows as infallibly as though it were written up in the sky, that there is at that moment far more invisible watery vapour in the upper atmosphere than the air there is capable of holding much longer in suspension, wherefore such extra moisture must very shortly be deposited as rain.

This then is the "rain-band spectroscopy" established by the Edinburgh experimenter; and it may be now successfully practised with the smallest spectroscopes either at home or abroad; when one is travelling as well as when stationary, for it occupies only a moment of time each day, as the merest glance will tell whether the rain-band preceding D is much stronger or less strong than the normal quantity; and with all the more certainty on account of the low-sun band immediately following D in the spectrum, enabling a differential, as well as an absolute, estimate of darkness to be formed. While in any but very cold and wintry weather, when Nature herself tilts the balance for rainfall by a very small addition to the watery vapour in the air, the spectral indications are easily read off and apprehended. They have also been found as certain at sea, in South Africa, and India, or wherever the system has been carried, as in Great Britain during the best part of its summer season.

If the research be further prosecuted with large dispersions, high magnifying powers, and on the direct light of the sun, the hazy bands above spoken of as existing in the general daylight, are found in the same spectral places, but breaking up into scores and hundreds of fine lines; while the range of visible spectrum then extending from the B limit of the mere sky and indirect sun's light, to great A and beyond it—the intermediate groups of lines called "little *a* and its preliminary band" will be found a still more powerful "rain-band" than that near D. For though they, little *a* and its preceding band, are composed of lines vanishingly thin, few and far apart in dry weather and as seen in a high sky, yet their interstices in damp weather become peopled with myriads and myriads of black lines, so as at last, indeed, in a setting sun, to block up the whole space of each group, from one side to the other, solidly; and then actually to dwarf the almost proverbial spectral colossus "great A," into a mere line comparatively puny and unimportant.

The Red-End of the Solar Spectrum.—"There must surely be some mystery of difficulty," thought the experimenter, "touching the red-end of the spectrum of the high sun, or the able Ångström, of Upsala, would not have omitted it in his otherwise grandly perfect normal solar spectrum map; while some points in the Royal Society's Himalayan solar spectra would have been very differently rendered." Now one undoubted obstacle to mapping that part of the spectrum well, is undoubtedly the faintness of its light; wherefore an idea immediately occurred to the new worker that the qualities of his aurora spectroscope were the very desiderata for both the red, the ultra-red, and for everything, in fact, that the very beginning of the solar spectrum has to show beyond, or earlier than, the point where Ångström's spectrum commences its admirable delineations with the rudimentary lines of only little *a* and its preliminary band.

But the summer of 1877 threatening to be hopelessly cloudy in Scotland, the experimenter, after considering the various *pros* and *cons* of many southern stations, decided on trying Lisbon, as the place of all others giving the highest summer sun, the best climate, and most social facilities, with least time lost in getting there. And then he further happily experienced, not only that the magnificent steamers of the Pacific Steam Navigation Company of Liverpool, are the most admirable means of accomplishing the ocean transit; but that the directors of that Company are most favourably and liberally inclined to help on any really scientific matter when for the sake of science alone.

Hence it was that in June and July, in Portugal, with his Edinburgh spectroscope and a heliostat of simple construction worked for him by his Wife's hand and eye, the experimenter was enabled to see and map at noonday, and, day after day, in a high sky, free from ordinary telluric effects, all that portion of the solar spectrum outside, or situated preliminarily to, Ångström's shortened beginning; viz., the matchless series of lines that go towards forming the colossal groupings of both great A and its grand preliminary band; then beyond that the very strong line Y and the groups of finer lines on each side of it; and beyond that again, near the beginning of all *visible* spectral light, the strong line X, and certain thinner lines on either side of it.

Photography, as Capt. W. de W. Abney has admirably shown since then, can take account of many more lines still; and some of them so very far away beyond all *visible* red light, as to remind one of those other lines recorded by Dr. Draper, the elder, in his celebrated Daguerreotype spectrum taken in 1843, lines which are quite outside the pale of all optical spectra. But the human eye had probably never, up to 1877, seen more in the "red" than what the Edinburgh experimenter's roughly built-up aurora spectroscope showed on this occasion: and the whole result, as contributing at last the head-piece required for Ångström's normal solar spectrum, was described in the 14th volume of the "Edinburgh Astronomical Observations," published towards the end of the same year 1877. It was accompanied there by a map, extending from the beginning of all visible light, and including 62 lines up to the groups of little *a*, so correctly represented in themselves by the philosopher of Upsala.

(*To be continued.*)

EXPERIMENTAL RESEARCHES IN ELECTRICITY[1]

SUPPLEMENT TO PART III.—*The Electric Condition of the Terminals of a Vacuum-Tube after their connection with the Source of Electricity has been broken*

THE question has been mooted whether there is a polarisation of the terminals of a vacuum-tube after the discharge through it has been interrupted by breaking connection between it and the source of electricity. This question is to be understood in the sense—does there exist a *chemical* polarisation as is the case for instance with the terminals of a voltameter under similar circumstances?

The problem is by no means easy of solution. The authors believe, however, that the few experiments they describe, selected from a long series, will show that there is really no such polarisation of the terminals.

In the first instance the case of the voltameter is considered; the arrangement of the apparatus employed in the experiments is shown in Fig. 1, where K K′ represent

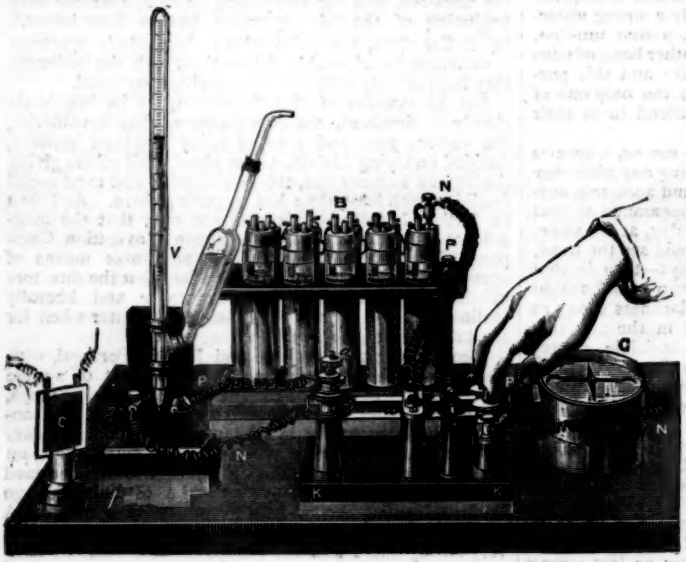

FIG. 1.

a special key for breaking connection between any piece of apparatus and the battery, B, and connecting it afterwards instantaneously with a galvanometer, G. The terminals of the battery are attached respectively to the screw-clamps, *c* and *d*, carried by an ebonite bar, supported on two ebonite columns, touch-points in metallic contact with *c* and *d*, pass through this bar, so that when the brass springs, *a e* and *b f*, are allowed to rise and press against these touch-points, the battery is in metallic connection with the screw-clamps, *a* and *b*, and any piece of apparatus attached to them, as, for example, the voltameter, V. The voltameter employed has a resistance of 20 ohms; its platinum electrodes are 2·5 inches long and 0·025 inch in diameter, and are separated 0·25 inch; it is charged with dilute pure sulphuric acid in the proportion of 1 volume of acid, sp. gr. 1·84, to 8 volumes of water. When the springs are suddenly pressed down by the fingers placed on the ebonite disks, *e* and *f*, the connection is broken between the voltameter and the battery, and it is connected instantaneously with the galvanometer G. The galvanometer actually employed was not that shown in the figure, but a Thomson galvanometer, whose constant, $C = \frac{1 \text{ volt}}{1 \text{ megohm}} = 1{,}874$ scale divisions. On connecting a battery of 10 chloride of silver cells with the voltameter for a minute or less, and then suddenly pressing down the springs *e* and *f*, there was a deflection to the left, say, of more than 1000 scale divisions, although the $\frac{1}{9\frac{1}{9}}$ shunt was used to reduce the current through the galvanometer; therefore, the deflection without the shunt would have been more than 1,000,000 divisions. By comparing this deflection with that produced by a half microfarad condenser, charged with 240 cells, it was ascertained that the deviation produced by the voltameter was equivalent to that of 111 microfarads.

The small condenser shown at C, Fig. 1, was substituted for the voltameter; it is made of a thin plate of glass 2 inches square and 0·0115 inch thick; the tinfoil coatings being 1·5 inch square, its capacity was found to be 0·00055 m.f. When charged with 3,600 cells, and afterwards connected with the Thomson galvanometer through the $\frac{1}{9}$ shunt, by pressing down *e* and *f*, the deflection was 136·5 divisions to the left; this multiplied by 9·92, the value of the shunt was equivalent to 1,354 divisions.

The apparatus, shown in Fig. 2, which was constructed for another object already described,[1] was connected with *a* and *b*; it consists essentially of two disks, 3·1 inches diameter, placed 0·13 inch apart. The capacity of this apparatus, when used as an air-condenser, was determined, and found to be 0·000058 m.f. With 3,600 cells no discharge took place, and it merely charged up as a condenser. The deflection produced, when the keys *e* and *f* were pressed down, was (without shunt) 150 divisions, still to the left. It is evident, therefore, that the direction of the deviation throws no light on the question, for it is the same with the voltameter as with the condenser.

Tube 73, containing a residuum of acetylene, was now substituted for the air-condenser; it is 26·5 inches long and 1·5 inch diameter, the distance between the termals 23 inches; this tube was connected with 3,600 cells, current 0·00681 W. The tube potential was found to be 2,980 cells, and its resistance 449,500 ohms. On pressing down the springs *e* and *f*, so as to break connection with the battery and connect the tube with the galvanometer, there was a deflection of 11 divisions to the left, the same as before. The current was only

$$\frac{11}{1874 \times 1{,}000{,}000} = \frac{1}{170{,}000{,}000} \text{ W.}$$

The diagram, Fig. 3, will illustrate the action of the special key, Fig. 1. When the handle is moved to the left, the tube T T′ is placed in metallic connection with the battery, whose terminals are shown attached to *c* and *d* (this is equivalent to the springs being allowed to press upwards against *c* and *d*, Fig. 1); when the handle is moved to the right, then the discharge of the battery through T T′ ceases, and the terminals of the tubes N and P are connected with the galvanometer, the extremities of whose coil are attached to *e* and *f* (this is equivalent to pressing down the springs in Fig. 1).

On another occasion with the same tube, No. 73, with

[1] "Experimental Researches on the Electric Discharge with the Chloride of Silver Battery," by Warren De La Rue, M.A., D.C.L., F.R.S., and Hugo W. Müller, Ph.D., F.R.S.

[1] *Phil. Trans.*, vol. clxxi. p. 76; NATURE, vol. xxii. p. 152.

a discharge from 2,400 cells, the deviation to the left on passing down *e* and *f* was 20 divisions.

Tube 199, with a hydrogen charge, was now substituted; pressure 2 millims., 2,632 **M**, 5,100 cells, current 0·01639 W. This tube has already been described (NATURE, vol. xxii. p. 176); it is 37 inches (94 centims.) long, and 5⅛ inches (14·8 centims.) in diameter. The distance between the terminals, a ring and a straight wire, is 33·5 inches (85 centims.). In the first place the battery was connected direct to the galvanometer, the positive to *e* and the negative to *f* (that is, in the same direction as if the positive were attached to *c* and the negative to *d*). A short piece of wire was inserted between *e* and *f* as a shunt, and the $\frac{1}{100}$ shunt was also used with the galvanometer, the direction of deviation was found to be to left, which it was desired to know.

On pressing down *e* and *f*, the deviation was to the left, and only amounted to 2 divisions. On another occasion, at the same pressure, 3,900 cells, current 0·02925 W., the deviation to the left on pressing down *e* and *f* was from 3 to 5 divisions.

The same tube, with a charge of coal-gas, pressure 3 millims., 3,947 **M**, current 0·01705 W., deflection, on pressing down *e* and *f*, 7 divisions to left.

The same tube, with air, pressure 1·5 millims., 1,974 **M**, current 0·02728 W., on pressing down *e* and *f*, deviation 20 divisions. The deviation was, therefore, greatest with air; but if due to a chemical polarisation, it would have been *a priori* expected to be greatest with coal-gas, which is a mixture of decomposable molecules. The result of the experiments with tube 199 gave the following deviations:—

Hydrogen.	Coal-gas.	Air.
3	7	20

Again, tube 199, 2,400 cells, pressure 1 millim., 1,316 **M**, current 0·02456 W., deflection on pressing down the keys, 16 to left; with 1,500 cells no discharge, yet a deflection of 10 divisions to the left was produced on pressing down the keys. The deflection in the latter case being clearly due to a static charge.

Experiments were now made in air with an apparatus similar to that already described in NATURE, vol. xxii. p. 174, but with disks instead of points, in order

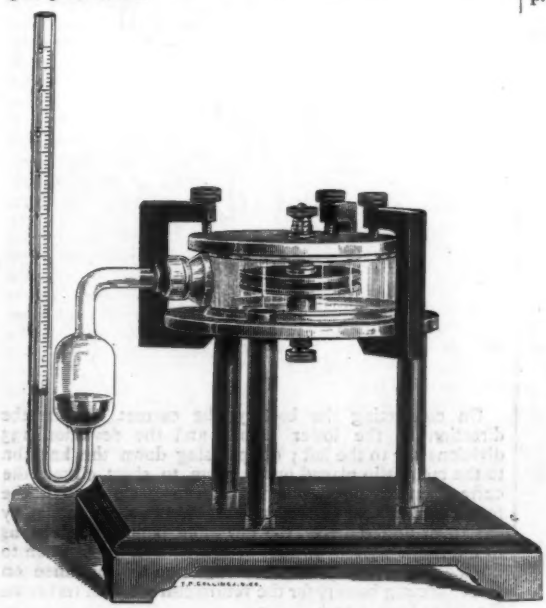

FIG. 2.

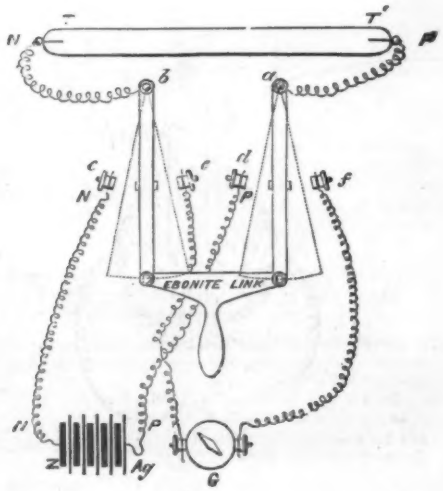

FIG. 3.

to obtain a vacuum vessel with large terminals. The terminals are two disks a little over 4¼ inches (11 centims.) in diameter, and in the first instance were placed 3 inches (7·62 centims.) apart. Pressure 4·5 millims., 5,921 **M**, 2,400 cells, current 0·04366 W., deviation on connecting the disks with the galvanometer, 10 divisions to left.

With 1,200 cells, no discharge took place, but on connecting the galvanometer a deviation of 27 divisions to the left was, nevertheless, produced.

At a pressure of 20 millims., 26,316 **M**, with 3,900 cells, no current passed, but the deviation on connecting the galvanometer, was 66·6 divisions to the left.

The disks were now placed at a distance of 2 inches (5·08 centims.), the pressure being still 20 millims., and the battery 3,900 cells, the discharge now took place, current 0·03896 W., deflection on connecting galvanometer 8·5 to left.

On reducing the battery to 2,400 cells, the discharge did not take place, but a deviation of 43 divisions was produced on pressing down *e* and *f*.

The disks were placed at 1 inch (2·54 centims.) apart, same pressure, with 3,900 cells, the current was 0·04201 W., deviation to left on connecting the galvanometer 13 divisions.

2,400 cells would not pass, but a deviation to the left of 47 divisions was obtained on connecting the galvanometer.

The following are the results of these experiments with the disks at various distances:—

Distance, inches.	No. of cells.	Pressure. mm.	Current.	Deflection on connecting galvanometer, divisions.
3 ...	1,200 ...	4·5 ...	did not pass	... 27·0
3 ...	2,400 ...	4·5 ...	passed	... 10·0
3 ...	3,900 ...	20·0 ...	did not	... 66·6
2 ...	3,900 ...	20·0 ...	passed	... 8·5
2 ...	2,400 ...	20·0 ...	did not pass	... 43·0
1 ...	3,900 ...	20·0 ...	passed	... 13·0
1 ...	2,400 ...	20·0 ...	did not pass	... 47·0

So that in every case when the current had not passed

the deflection was the greatest on connecting the terminals with the galvanometer.

If the fact already pointed out be taken into account, that with a constant battery-potential, the difference of potential between the terminals of a vacuum-tube varies, in the same gas, according to the degree of exhaustion, it follows that as soon as a discharge takes place, the potential of the terminals will be lowered. One would therefore expect to find what the before-cited experiments indicated, namely, that the static charge of the terminals would be greater when no discharge takes place than after it has occurred, notwithstanding that a larger number of cells may have been employed in the latter case than in the former, for the authors have shown (*Phil. Trans.*, vol. clxxi. p. 67) that a tube-potential may be only 430 cells, although the battery connected with its terminals is 11,000 cells.

The authors believe, therefore, that the experiments point conclusively to the deduction that the current obtained from the terminals of a vacuum tube, after having been disconnected from the battery, is solely due to a static charge and *not* to a *chemical* polarisation.

An experiment was made with the apparatus arranged as in Fig. 4, a tangent galvanometer being inserted in the

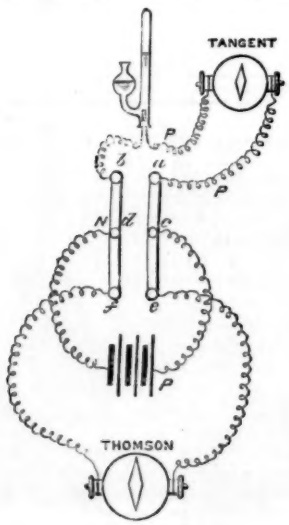

FIG. 4.

circuit between the battery and the voltameter, the $\frac{1}{1000}$ shunt being used with the Thomson galvanometer.

No. of cells.	Current indicated by the tangent galvanometer. W.	Deflection of Thomson galvanometer, with shunt $\frac{1}{1000}$, on pressing down e and f.	Divisions.
1 ...	0·00000 ...	220 × 995·3[1] ...	218,930
2 ...	0·00415 ...	765 ,, ...	761,380
3 ...	0·03463 ...	984 ,, ...	978,820
10 ...	0·14660 ...	990 ,, ...	985,150

On keeping down the keys e and f after the voltameter had been connected with three cells, the deflection, which at first was 984 divisions, fell in—

1 minute to	110
2 minutes to	80
3 ,,	68
4 ,,	60
5 ,,	55
6 ,,	52
7 ,,	49

[1] The value of the $\frac{1}{1000}$ shunt.

so that it was evident that a current was kept up by the voltameter for a considerable time after the battery had been disconnected.

In order to render evident the direction of the current of polarisation of the voltameter the apparatus was arranged as in Fig. 5, that is, the Thomson galvanometer, with $\frac{1}{1000}$ shunt, was inserted in the circuit between the battery and the voltameter. An adjustable shunt was fixed between a and b to permit the greater part of the current to pass through it. A plate of metal, $s\,s$, was provided to slip under e and f to short circuit the return current through the galvanometer. The shunt which was found just sufficient to carry the major part of the current, and yet permit sufficient to traverse the voltameter to produce a just visible evolution of gas, was 13 ohms.

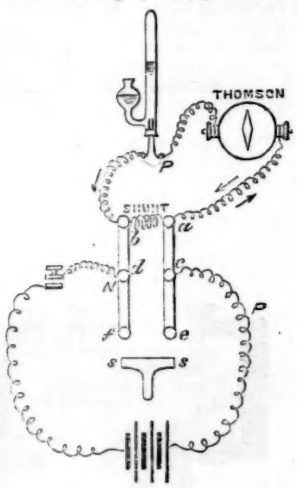

FIG. 5.

On connecting the battery, the current was in the direction of the lower arrow, and the deviation 133 divisions say to the left; on pressing down the keys on to the metal slip placed under them to short circuit the current, after the battery had been disconnected, the return current was in the reverse direction, as shown by the upper dotted arrow, the deviation being 425 divisions to the right. Even without pressing down the keys on to the metal slip nearly the same deviation was obtained on disconnecting battery for the return current then traversed the shunt from a to b.

On substituting either the bell-jar, with disk terminals, or the tube 199 for the voltameter, the deflection of the return static charge was in the same direction as the return current from the voltameter, so that, as was before stated, no inference can be drawn from the direction of the current as to its being produced by polarisation or a static charge. The authors conclude by saying:—We think, however, that we have shown that the effect in the case of a vacuum-tube is due to a static charge, and not to a polarisation of the terminals. We rest our opinion mainly on the fact that a greater deflection is produced, when the potential has not been lessened by a discharge through the tube, than that which occurs after the discharge has taken place, which, it had been surmised, might possibly produce a chemical polarisation.

THE LATE M. GAUGAIN

SCIENCE has to deplore the loss of an industrious but unobtrusive worker in the person of Jean-Mothée Gaugain, who died at the village of St. Martin d'Estreaux,

near Bayeux, on the 31st of May, 1880. His name is honourably associated with experimental researches in a good many of the less-frequented bye-paths of electrical science. Living in a time which may well be regarded as the transition period, during which electricity has passed from the stage of a phenomenal and experimental science to one of exact mathematical relations, some of Gaugain's investigations are already superseded by the later and more comprehensive researches of a younger generation. Yet he has done good work, which will live to carry down his name along with that of Peltier, of Pouillet, and of Becquerel, and with the still greater names of Arago and of Ampère.

His earliest contribution to science of which we are aware was a memoir published in 1853, under the title "Note sur les Signes Electriques attribuées au Mouvement de la Chaleur," and in the same year he brought out his tangent galvanometer. The essential point of this instrument consisted in employing as a coil several turns of wire of increasing diameter arranged about a conical surface, at whose imaginary apex was placed the small magnetic needle, each of the coils thus subtending the same solid angle at this point. This arrangement, to which Gaugain was experimentally led, was in some points virtually anticipated by the tangent galvanometer of Helmholtz, in which, however, a symmetrical arrangement was employed. In the same year Gaugain announced the discovery that continuous currents of electricity could be produced by the continuous friction of two dissimilar metals upon one another. The next two years saw him employed in investigating the electricity produced by evaporation and by combustion. In 1856 he produced his double-condenser electroscope, designed, like the condensing-electroscope of Volta, for the investigation of the electrification due to contact of dissimilar substances. At the same time he published some observations on the behaviour of amalgams of sundry metals, and showed that in a voltaic pair the amalgam of zinc was more electropositive than zinc itself, while the amalgam of cadmium was on the other hand, more electro-negative than the pure metal. From 1856 to 1859 Gaugain was occupied with important inquiries on pyroelectricity, and he succeeded in establishing sundry laws, with respect to the electricity of the tourmaline in particular, which had escaped previous observers. The results he arrived at were published in the *Annales de Chimie et de Physique*, and comprised a number of curious and unexpected results. The tourmaline, which at ordinary temperatures is a bad conductor, even for high-tension electricity, begins to conduct at 400° or 500° C., and on cooling is still found to conduct; but if washed in water and dried carefully it once more insulates. All tourmalines are not equally active, those of Brazil, green or blue in colour, being the most electrical. In order to obtain a measure of the amount of electricity furnished by a tourmaline whose poles were united by a metallic circuit, he devised a discharging gold-leaf electroscope, and by means of this instrument showed that a number of tourmalines united by their similar poles gave quantities of electricity proportional to their number, while if united in single series they gave no more than a single long one, thus behaving like batteries of great electromotive force and of almost infinite internal resistance. The quantities of electricity furnished by tourmalines of equal lengths but of different thickness while passing through equal ranges of temperature he found to be proportional to the cross-sections of the crystals, again agreeing with the law of Ohm as applied to batteries of very high internal resistance. Gaugain also showed the quantity of electricity thus flowing through the tourmaline in one direction during a rise of temperature to be equal to that flowing in the reverse direction during a corresponding fall. The year following the discharging electroscope was usefully employed in verifying Ohm's law as applied to other bad conductors. Volta's contact theory occupied Gaugain at several periods of his career, and he established amongst other interesting results that there is a difference of potential between a piece of platinum which has been dipped into acid, and one which has been dipped into alkali, even though both have been subsequently washed. Gaugain also conducted a number of careful researches on specific inductive capacity, on the capacity of cables, on the residual charge of condensers, and on what he termed the variable electric state of a condenser communicating with the soil by a bad conductor, in which, when discharged by disruptive sparks or by the discharging electroscope, the time-intervals of the discharges were found to form a geometric progression. His extended observations on condensers of spherical, cylindrical, and flat forms were communicated to the Académie des Sciences in three special notes. In later years Gaugain devoted himself to the examination of the effects of heat upon the magnetism of steel tubes and bars, and found the remarkable result that a bar magnetised powerfully while hot may when cooled exhibit a reversed polarity, and *vice versâ;* also that the magnetisation by a strong current penetrates deeper than that due to a weaker current. He also brought to light sundry analogies between the behaviour of magnets under magnetic force, and of matter generally under mechanical forces.

Born in Normandy in 1810, he entered the École Polytechnique at about the age of eighteen, and afterwards attended the École d'Artillerie at Metz, after which he adopted metallurgy as his profession. Gaugain worked during the closing years of his life in isolation and in straitened circumstances, assisted by his only daughter, who devoted herself to him. His researches, though several times rewarded with academic recognition, were not in themselves productive of gain; and the *prix Gegner*, an annual grant of 4,000 francs, given *à un savant pauvre afin de l'aider dans ses recherches*, awarded to him for five years past, was a welcome amelioration of his position in a time of failing health and during the painful illness to which he succumbed at the age of seventy years.

S. P. T.

A CHAPTER IN THE HISTORY OF THE CONIFERÆ

IN working out the Eocene coniferæ, in continuance of the monograph which the Palæontographical Society are kindly publishing and illustrating in a sumptuous manner, some reflections upon the past history of the more prominent Eocene genera, such as Araucaria, Podocarpus, Dammara, Sequoia, &c., have occurred to me, which, although being perhaps outside the scope of the Palæontographical Society's work, may not be uninteresting to the general readers of NATURE. I have therefore tentatively brought forward the present chapter on Araucarias without yet having any definite intention of putting together my notes upon the other genera, in the present form.

Araucaria,[1] Jussieu.—The earliest traces of distinctly coniferous wood known, those from the Carboniferous, were for many years thought to belong exclusively to the Araucarian type. This supposed prototype became, according to Schimper, modified in successive ages, and he endeavours to trace these modifications through the extinct genera Walchia, Ullmannia, Araucarites, Voltzia, Ptycholepis, Pachyphyllum, and Cunninghamites. Lesquereux, however, carries the actual genus Araucaria to as far back as the Trias, and unmistakable cones of both sections of the genus have been described by Carruthers from the Stonesfield, Yorkshire, and Somersetshire oolites; fossil forms agreeing closely with these have been also found in the Jurassic of India. It is not

[1] From Araucanos, a people of Chili, in which country *A. imbricata* abounds, and furnishes the principal food of the Indians.

definitely known at present in cretaceous rocks, for the large fossil cone figured by Heer as *Araucarites nordenskiöldi*, from the upper cretaceous of Spitzbergen, is a very indistinct coaly mass, and as he suggests, possibly cycadaceous.[1]

The Araucarias thus appeared to have declined since Jurassic times, and Schimper states that, with the Tertiaries, they became extinct in Europe. Thiselton Dyer[2] goes further, and has even stated that, so far as we know, they have been extinct north of the equator since the Oolitic age. It is certain, however, as I hope to show, that at least one section of them abounded in Europe during the Eocene age, and probably did not quit it until the Miocene.

The existing Araucarias present a singular appearance when contrasted with other trees, and would be looked upon from their aspect alone as unmistakably archaic in character. They have been divided by Salisbury[3] into two very distinct sections: Columbea, or true Araucarias, and Eutacta, or the needle-leaved false Araucarias. They are exclusively confined to the southern hemisphere, Columbea alone being represented in South America, and both sections in Australia and the adjacent isles.

The section *Columbea* possesses but four species, which are, however, very distinct from each other and of great interest. The most familiar is the common *Araucaria imbricata*, or Monkey-puzzle. It is almost confined to Chili, forming vast forests which extend upon the slopes of the Andes from the snow-level to about 1,500 or 2,000 feet downwards. The trees reach 150 feet in height, and with their dark pendulous foliage are of imposing grandeur. Their appearance when full grown can scarcely be realised from the young trees in England, but an exceptionally fine specimen is at Windsor, and a carriage-drive leading to a nobleman's house, near Armagh if I remember rightly, is bordered by high banks of large and, for our country, well-grown trees of this species, and presents a strikingly dignified effect. The cones are very large, and the seeds, which are highly nutritious, form the staple food of the Indians. The second South American species, *A. brasiliensis*, is somewhat similar in appearance, and reaches 100 feet in height. It also forms immense forests, and produces edible nuts, but as it will not live in our climate without protection, is less frequently seen in cultivation.

The Australian species are even more strange in aspect. *Araucaria Bidwillii* forms a majestic tree, growing to 150 feet in height, and confined to a tract 30 miles long by 12 on the east coast near Brisbane, where it far overtops the other forest trees. *A. Rulei*, a smaller though equally beautiful tree, is chiefly remarkable for its singularly restricted range, being only indigenous to Porte Molle, one of the Caledonian Isles, where it is confined to the summit of an extinct volcano, but half a mile in radius, and exposed to extremes of heat and cold that appear destructive to other kinds of vegetation, for hundreds of feet below it.

The Columbeas have not been met with fossil either in the Eocene or Cretaceous rocks, probably because their stations are mostly high rocky ridges, where there is an absence of water, rendering it unlikely that their remains would find their way into marine or fluviatile sedimentary strata. We must by no means infer, therefore, that species belonging to this section did not exist in Europe contemporaneously with the species of Eutacta that have been found.

The section *Eutacta* has terminal globular cones with broadly-winged and generally persistent scales and falcate needle-like leaves. There are but three existing species, all of gigantic dimensions, for two of them attain a height of over 200 feet, and the third 150 feet. *Araucaria Cookii*, or the Norfolk Island pine, a native of New Caledonia and New Hebrides, presents a fantastic columnar-like growth, giving the trees when seen from a distance somewhat the appearance of a grove of ship's spars 200 feet or so in height. *A. excelsa*, indigenous to Australia and Norfolk Island, is an even more majestic and colossal tree, towering to a height of 230 feet, with a trunk of some 30 feet in girth. The third species, *A. Cunninghami*, I wish to describe in more detail, for I have ascertained, conclusively I believe, that it, or a species indistinguishable from it, flourished abundantly in our latitude and longitude in the Middle Eocene period.

A. Cunninghami, like many Coniferæ of the southern hemisphere, has two slightly distinct forms of leaf, those of the young plants being straighter, more sabre-like, and horizontally disposed than those of the more fully developed tree, which hitherto have alone been met with fossil.

The foliage of the more full-grown tree is composed of moderately short falcate needle-like leaves, quadrangular in section, thickening at the base, and with the lower side produced and decurrent on the stem. These are disposed all round the branches, and leave the stem at first at right angles to it, and then gently curve upward and inward. This arrangement causes each leaflet to be free or seldom in contact one with another, and is an important character in distinguishing the species by its foliage when other organs are absent. The terminal branchlets are generally simple for 5 or 6 inches, and then branch shortly but copiously, and chiefly horizontally. These branchlets apparently represent one year's growth, for they are articulated at the base, and are annually shed in abundance by the trees. Branchlets resembling these in the minutest particulars are to be found in great quantities in the Eocene beds at Bournemouth.

Other coniferous foliage, however, resembles *A. Cunninghami*, especially that of some of the cultivated *Sequoia gigantea*, so much so that I had difficulty in removing the prejudice from Ettingshausen's mind, shared by all the Teutonic palæobotanists, in favour of referring all this type of foliage to Sequoia. Before it can definitely be said to belong to *A. Cunninghami* these types of foliage must of course be considered.

In the first place the foliage of *A. Cunninghami* is easily distinguishable from that of the other Araucarias in the section; *A. excelsa* having leaves more at right angles, more laterally disposed, and foliage less branching, and *A. Cookii* possessing the leaves broader and in contact with an imbricated appearance, while every articulated branch is simple. The other Coniferæ which resemble it are *Creptomeria japonica*, in which the leaves are much longer and straighter, and quit the stem at an angle of about 35°; *Arthrotaxis selaginoides* and *Dacrydium araucaroides*, which have the imbricated appearance of *A. Cookii*; and *Sequoia gigantea*, which is much the nearest in general habit. The leaves of Sequoia differ in being rather longer in proportion, less regularly disposed and curved, leaving the stem at a very acute angle, and hugging it more closely, so that their points irregularly overlap and touch each other. Its foliage in the wild state seems always to be very much smaller, and the larger foliage it seems sometimes to assume away from its native habitat, shows very distinctly the seasonal variations in the size of the leaves so characteristic in the other existing Sequoia, *S. sempervirens*. The Bournemouth foliage differs from all these materially, but as already stated, resembles that of *Araucaria Cunninghami* in so close a degree as to be indistinguishable from it by any discoverable character.

Apart from the foliage, however, there is other evidence in support of the view that this is really *Araucaria*

[1] "Flora foss. Arctica," vol. iii. Pl. xxxvii. p. 126. Heer says the figure is much too distinct, and that the position and arrangement of the scales can only be made out with the greatest trouble. Restored as it is, it possesses no distinctively Araucarian characters, while no branches of Araucaria have been found that could be placed with it. Cycadaceous and Sequoia foliage moreover abounds in most cretaceous rocks in high latitudes.

[2] Royal Geog. Soc. *Proceedings*, 1878, vol. xxii. p. 427.

[3] *Trans. Linn. Soc.*, vol. viii., 1807, pp. 308-317.

Cunninghami. Although the branchlets are most abundant in some of the beds, both marine and freshwater, no trace whatever of the cones could be found. I was at first surprised at this, for it is generally more common in beds of marine origin, as at Bracklesham, Barton, Sheppey, &c., to meet with cones than with foliage, and no instance of the presence of coniferous foliage only, in a sea-deposit of any age had previously come under my notice. I was so puzzled that I spent several days in digging and tracing out these branchlets and vainly trying to find the attached fruits—the cause of whose absence should have been clear. The cones, 3 inches long and nearly 9 inches in diameter, are so exceedingly dense and heavy that they have no power of flotation, and their presence in beds of fine drifted sediment could therefore only be due to some rare accident. On the other hand, the small light cones of Sequoia would, like those of Pinus, everywhere drift by flotation, and necessarily not unfrequently become imbedded with the foliage. Although I found no cones, the female terminal buds present the peculiar constriction and then swelling, so characteristic of Araucaria.

The distribution of *Araucaria Cunninghami* at Bournemouth is very clearly defined, and tells as plainly as possible that its habits when existing in our latitudes did not differ from those it now possesses. No trace of it is met with west of the pier in the beds whose floras may be thought, from their characters, to have come from districts away from the sea—but east of the pier it abounds everywhere, in company with fan-palms, eucalyptus, aroids, ferns, &c., and in certain beds of mud and muddy sand of the marine series, the branchlets, in marvellous preservation, are seen to cross each other in every direction.

The existing *Araucaria Cunninghami* forms vast forests on the shores of Moreton Bay, on the alluvial banks of the Brisbane River, and grows in the greatest profusion in the brush forests of the Richmond River. "The trees seem to thrive best near the coast, attaining in such a situation their greatest height, often from 100 to 130 feet,[1] but gradually diminishing in height the farther the trees are inland. It would appear from this that the sea air has a great effect upon it."

The "brush" forests, in which *A. Cunninghami* very generally occurs, although it is not exclusively confined to them, are thus described by Moore:—

"The 'brush' is characterised by denseness of growth, the altitude and beautiful dark green foliage of the trees, the presence of lofty climbing plants, which extend their slender pliant branches considerable distances, and by this means often embracing, as it were, into one common bond, many of the loftiest and largest trees. . . . Another characteristic of forests of this description is a thick undergrowth of numerous kinds of ferns and other plants. Palms and tree-ferns also usually abound, the former reaching a height, in some instances, of at least 130 feet. . . . On the stems and branches of the trees numerous kinds of epiphytal ferns and orchids grow, which, with the other plants referred to, contribute materially to give such forests a very tropical appearance."[2]

It is clear, from the *débris* of trailing Smilaceæ and Aroids, and from the remains of large fan-palms and ferns, that our Eocene "brush"-growth must have been very similar to this in appearance. The physical aspects of the former stations of Araucaria on the alluvial banks of the great Bournemouth River in close proximity to the sea, as we have ascertained, and its probable extension along the shores of what must have been the *east coast* of the submerged continent seem to approximate to those it now occupies on the Brisbane River and the shores of Moreton Bay on the east coast of Australia. Nothing can be more impressive indeed than the remarkable agreement in habit, as far as we can trace, between the Araucaria and associated plants that have passed away and those that survive. The long-imbedded plants of our Eocene coasts seem to have risen up and to live again in this far-off country, and by what we see there we are able to picture the long sandy coasts, beaten by an ocean surf and fringed with dark-foliaged and gigantic Araucarias, gum-trees, luxuriant palms and ferns, whose remains have helped to form the present pine and heather-clad cliffs of Bournemouth. If we contrast this with the comparative absence of any associated vegetation in the Mammoth Grove, we see how opposed the intended reference of these branches to Sequoia would have been to any known natural grouping.

Elsewhere in Great Britain we have little trace of anything referable to Araucaria younger than in the Jurassics, except certain foliage at Sheppey and the foliage from the basalt of Antrim, referred by Bailey to Sequoia as *S. du Noyeri*, about which however I am not yet able to express an opinion. In France, from many Eocene localities, undoubted Araucaria branches have been obtained, though none of them seem to be specifically identical with ours, and some appear more of the *A. excelsa* type.

In Central Europe, from Sotzka, Häring, Monte Promina, Bilin, &c., in Tertiary beds whose exact age is not yet satisfactorily determined, a somewhat similar foliage abounds. This was originally described as Araucarites, and indeed at Häring a young cone with every characteristic of Araucaria was found in the same bed with it.[1] All of them were subsequently transferred to Sequoia, which many certainly more nearly resemble in the direction and arrangement of the leaves; yet the absence of any Sequoia cones which can, so far as I know, be directly connected with them, and the presence of a characteristic Araucaria cone should, at all events, induce caution in believing the whole of this type of foliage met with in Central Europe during the Middle or Upper Eocene to belong to an ally of *Sequoia gigantea*. It is quite open to doubt whether, as Heer's determination of two fragments would imply, this species known as *S. sternbergeri*, whatever its real character may be, persisted as late as the Miocene of Oeningen. On the other hand, the presence of fossil Sequoiæ of the Wellingtonia type within the Arctic circle is undoubted, though Heer appears to have made more species than were necessary.

The presence of an Araucaria, indistinguishable from *A. Cunninghami*, in our latitudes at a time not more remote than the Middle Eocene, is of interest, for although many of our Eocene plants have been referred to Australian genera, there has always been doubt sufficient to render any confirmation of the supposed land connection with Australia of importance. While the association with it at Bournemouth, of Podocarps and Dammara, Eucalyptus, and many Proteaceæ, which are strictly forms of the southern hemisphere, is but natural, the presence of a needle-leaved conifer of the genus Pinus, even rare as it is, is singular. Such a union nowhere takes place at the present day, although in Mexico pines mingle with feather palms.

The presence in N. lat. 50° of a flora, now distinctive of the sub-tropics of the southern hemisphere, and of a north temperate flora in N. lat. 70°, during the Eocene period, can hardly fail to provoke wonder as to where the equator of heat was then situated. It is impossible to suppose that the equator of heat separated them as it does now, however far north it might be driven by shutting off the Arctic currents and leaving those of the Antarctic to circulate. Yet if the southern hemisphere flora were formerly to the north of the equatorial zone of heat, the question must arise as to how *Araucaria Cunninghami*,

[1] 150 feet. "Industrial Progress of New South Wales; Official Report of the Sydney Exhibition, 1870," Part II. p. 643. It is astonishing how very generally the dimensions of the Coniferæ of Australia and America are under estimated.

[2] *Loc. cit.*, p. 633.

[1] "Foss. Coniferæ," Goëppert, Haarlem *Transactions*, 1850, pl. 44, p. 237.

and other forms that are not tropical, could have reached their present habitat. The range of this Araucaria, although greater by far than that of the other Eutactas, is very definitely limited to a strip of coast in New South Wales between the Bellingen, a small stream about S. lat. 31° 40′, and Cape York in Queensland, in nearly 10° S. lat. It does not approach, therefore, to within nearly a thousand miles of the equator of heat, which is several degrees north of the true equator. They must either have crossed the equator from the south in præeocene times and subsequently become isolated and died out in their northern habitat, or have been originally indigenous to the north and retreated to their present stations. A passage must have been made in either case, for the present distribution of Coniferæ is against the supposition that any *identical species* could have extended synchronously in lowlands in both hemispheres, widely separated by the equator. If a general lowering of temperature had favoured their passage, the pre-existing tropical vegetation must have altogether died out, and the existing equatorial vegetation would present a comparatively new aspect. The absence of any of the Coniferæ that have ever been met with fossil in the plains of the tropical regions at the present day, and of any existing strictly equatorial plants, such as Gneta among Conifers, in the fossil floras, seems at first sight to show that it does do so and therefore lends some colour to what is at best merely a very crude hypothesis. A simpler supposition than that of a general lowering of temperature in the Tropics, until more facts are forthcoming, is that the passage was effected across high land, some of which may still remain in Sumatra and Java.

The specific identity which is apparent, of this and other Australian forms, with those of our Eocenes, proves that some, at all events, of the at present purely Australian genera, neither originated nor became differentiated, as Bentham supposed, in Australia. The endemic genera, he says, never spread far out of it, the only exceptions appearing in the Malay Archipelago, "especially Timor, New Guinea, and Borneo, and a few as far as Southern China."[1] Nothing could speak more eloquently of the path the migrations have taken, than these remnants left upon the road, nor go farther to prove the former connection with our antipodes, which the discovery in 1814 by Brown of 150 European plants, a number since greatly increased, growing endemically in Australia, first of all I believe suggested to us.

It may not be altogether a useless supposition to hazard, that if, as Saporta supposes, plants originated mainly if not wholly in northern regions, and migrated south, the continents of the southern hemisphere may be actually preserving, as in the present case, our Eocene flora, and have been inhabited in Eocene times by the Jurassic flora which preceded it, or by some intervening flora of which we have now but the scantiest records.

From what has been said the Araucarias are seen to be an archaic type, formerly most widely spread, now dying out and only lingering in restricted areas in the southern hemisphere, whose very specific differentiation was accomplished before the Eocenes began. May its value as food and use as the chief timber tree in the districts it still inhabits preserve it from an accelerated extermination at the hands of man.

J. STARKIE GARDNER

ON SOME POINTS CONNECTED WITH TERRESTRIAL MAGNETISM

THE remarks in NATURE, vol. xxii. p. 169, of Messrs. De La Rue and Müller in connection with their most interesting and important researches on rarefied gases induce me to ask the privilege of stating somewhat more fully than I did on June 17 what I conceive to be the position filled by a working hypothesis such as that then mentioned in the science of terrestrial magnetism. Let me begin with the aurora. Here we have a phenomenon which invariably accompanies magnetic storms, on which occasions it occurs simultaneously over a large portion of the globe. Again the recent researches of the above-named gentlemen render it very probable that auroral displays do not occur at a very great height, while it is conceivable that they may occur at times at an altitude of a few thousand feet. Here then we have a phenomenon which is intimately connected with sudden changes of the earth's magnetism. To this we may add earth currents as another phenomenon of the same kind, so that we have earth currents and auroral displays invariably associated with magnetic storms, when these are of marked violence. Now what is the nature of this connection? When we examine the formal laws of these associated phenomena we find that these lead us (almost irresistibly, as I think) to conclude that earth currents and auroræ are secondary discharges caused by sudden changes in the earth's magnetism, no matter how these changes are produced. So strong is the evidence of *form* in this instance that the late eminent magnetician John Allan Broun expressed to me his belief that earth currents and auroræ were connected with magnetic storms in the way above mentioned.

If this be assumed as the most probable working hypothesis, it is natural to take another step. If we have discharges produced in stationary strata by a changing magnet, may we not have discharges produced in moving strata by a constant magnet, and may not the motions and changes of motion produced by the sun in the upper convection currents of the earth give rise to electric phenomena which may explain the changes of terrestrial magnetism? Of course this is only a working hypothesis. Before it can possibly become an established theory we must have obtained from Messrs. De la Rue and Müller and from other observers that full and complete information regarding discharges in rarefied media which they are rapidly affording us, and we must likewise have obtained fuller information than we now possess regarding the directions and velocities of the convection currents in the upper regions of the earth's atmosphere. When this is done, the problem may be regarded as ripe for the mathematical physicist who may proceed with his calculations and either dismiss the hypothesis as untenable or increase the probability of its truth.

But in the meantime we are not ripe for this, and all that we can do is to regard the hypothesis as a working one, and endeavour by its means to elicit new facts regarding the *form* of the diurnal and other variations of terrestrial magnetism. I submit that in this respect the hypothesis has not been devoid of value. I have by its means been led to derive the fact that certain magnetic diurnal changes lag behind corresponding solar changes, just as meteorological changes would do—a fact which has since been confirmed by Mr. Ellis of the Greenwich Observatory. And I may be allowed to anticipate the results of work at which I am now engaged so far as to say that in the short periods which I am now investigating an increase or decrease of solar activity corresponds to an increase or decrease both of magnetical and meteorological activity.

Again, in conjunction with others, I have shown by preliminary discussions the probability of a progress of magnetic phenomena from west to east just as we know there is a progress of meteorological phenomena, only magnetic weather (if I may use the expression) appears to travel faster than meteorological weather. This last appears to me to furnish almost a crucial test in favour of this hypothesis, and through the courtesy of the Kew Committee, the Astronomer Royal, and Mr. Carpmael of Toronto I hope to be able soon to investigate this phenomenon in a more complete manner.

[1] Bentham, "Flora Australiensis," vol. vii.

Finally, I understand that the Kew Committee are about to take in hand the subject of the progress of magnetic weather and to investigate it in a manner peculiarly suitable to an institution possessing relations with numerous self-recording magnetic observations.

BALFOUR STEWART

NOTES

THE fund which has been established by the members of the Birmingham Philosophical Society for the endowment of original research already amounts to 700*l.* in donations, and to 70*l.* in annual subscriptions. Out of this a sum of 150*l.* per annum for three years has been voted to Dr. George Gore, F.R.S., which amount is, in the terms of the grant, placed at his disposal in order that he "may have greater facilities for continuing in Birmingham his original researches." The council of the society proposes to make other grants as soon as the funds will permit. We have already spoken of the enterprise and public spirit of this society in establishing the fund; it is gratifying that they have been able to make a beginning so speedily, and the success of the scheme cannot be doubted. Dr. Gore's address is now the Institute of Scientific Research, No. 67, Broad Street, Birmingham.

WE are glad to hear that Mr. L. Fletcher, M.A., Fellow of University College, Oxford, has been appointed to succeed Prof. Story-Maskelyne as keeper of the Mineral Department of the British Museum. Mr. Fletcher was appointed first assistant in the department a little over three years ago, and the energy and ability with which he discharged the duties of that appointment promise well for the future of the Mineral Department.

WE regret to have to announce the death of Mr. Henry Ludlam, which occurred last week from the rupture of a blood-vessel. He had been in failing health for some months, but seemed on the road to recovery when the hæmorrhage occurred. He was well known in the mineralogical world as one of the most assiduous and able of private collectors, and his valuable collection was one of the objects of interest which foreign mineralogists visiting this country wished to consult. He has carried out his intention, announced several years ago, of bequeathing the collection to the Jermyn Street Museum. This gift will render the collection of this museum second only to that of the British Museum, and will, in fact, render it a formidable rival in the case of some of the rarer and more beautiful minerals. Mr. Ludlam was always willing to allow his mineralogical friends to consult his collection, and also frequently supplied them with specimens for examination.

THE Council of the Society of Arts have awarded medals to the following gentlemen for papers read during the session which is just over:—Major-General H. Y. D. Scott, C.B., F.R.S., for his paper on "Suggestions for Dealing with the Sewage of London;" A. J. Ellis, F.R.S., for his paper on "The History of Musical Pitch;" John Sparkes, for his paper on "Recent Advances in the Production of Lambeth Art Pottery;" Henry B. Wheatley, F.S.A., for his paper on "The History and Art of Bookbinding;" W. Holman Hunt, for his paper on "The Present System of Obtaining Materials in use by Artist Painters, as compared with that of the Old Masters;" Thomas Fletcher, for his paper on "Recent Improvements in Gas Furnaces for Domestic and Laboratory Purposes;" John C. Morton, for his paper on "The Last Forty Years of Agricultural Experience;" Prof. Heaton, F.C.S., for his paper on "Balmain's Luminous Paint;" Capt. Abney, R.E., F.R.S., for his paper on "Recent Advances in the Science of Photography."

LORD NORTON has all along protested that he is not unfavourable to the teaching of science in elementary schools, and is evidently hurt at the incredulity with which his protestation is received by those one-sided individuals who persist in judging his intentions by his actions, and not his words. He is evidently of opinion that the only difference between himself and those who would maintain the Code unaltered, is one of method. There are people so benighted as to believe that as science deals with *things*, it is hopeless to teach it apart from these things; who believe that if you want to make children know what a daisy or a buttercup is like, and to understand its structure, the shortest and most effectual way is to show them the flower and take it to pieces in some sort of systematic way before their eyes. But these people are all wrong. Why should children and teachers put themselves to the trouble of soiling their hands by pulling to pieces nasty weeds, when the thing can be much better done from books? Lord Norton, as we learn from a contemporary, has resolved to triumphantly refute these deluded people, by himself compiling a series of reading lessons in botany, warranted to teach the children of our elementary schools all that it is safe and wholesome for them to know. Evidently modern science and its methods are all wrong; books, after all, are the only instruments of education, and the sooner we make a holocaust of all modern scientific implements and methods the better. Might we suggest to Lord Norton that after he has completed his botanical enterprise he might compile a series of lessons in engineering, civil and mining, for the purpose of saving the neophytes in these departments the necessity for spending their time in sooty workshops and stifling mines? In fact there seems no end to the enterprise which Lord Norton is about to "inaugurate;" if he is able to carry it on to completion, he will probably earn for himself a right to be considered the most remarkable educationist of his time. In the meantime Her Majesty's reply to the address which the Lords were persuaded to adopt is virtually a quiet snub; while in the Commons Mr. Mundella has declared that the Government have no intention of lowering the standard of education in the country. Does not this look rather bad for the success of Lord Norton's projected compilation?

IT is a tacitly-accepted practice, and one so beneficial to student-readers as to be almost imperative, that writers of original scientific memoirs should, wherever their researches touch upon common ground with those of older workers of standing, give references (at the very least in a decent foot-note) by which the student may be able to turn at once to the *ipsissima verba* of the possible authorities. We regret to notice an increasing tendency of late to slovenliness in the way of making such references on the part of some of the younger generation of enthusiastic would-be discoverers. Even the *Proceedings* of the Royal Society itself are not exempt from this modern weed, for in a recent paper we find the following given as references:—*Phil. Mag.*, 1850, *Pogg. Annalen*, 1858, and—for an important deduction from a paper by Clausius—*Phil. Mag.*, 1851. Is it too much to request the writers of Royal Society papers to be at least a little more explicit in their allusions? We cannot suppose that such references are made vague with any sinister purpose.

DR. P. P. C. HOEK of Leiden writes:—"The zoological station of the Netherlands Zoological Society for the summer months of this year is erected in the neighbourhood of Nieuwediep Harbour. The use of the station is free to the members of the Society and to strangers introduced by one of the members. The laboratory is furnished as completely as possible with all the implements—optical and steel instruments excepted—necessary for anatomical, histological, and embryological researches; it contains also a small collection of books necessary for a preliminary investigation and determination of the animals collected, &c. Special arrangements of a very simple but practical kind serve to keep alive the collected animals. Smaller and larger

excursions are organised every year by the station, and for these it always has at its disposal pilot-boats and other small vessels of the Dutch marine. Since its opening, in the summer of 1876, the station has repeatedly received proofs of appreciation from different quarters. Thus on the Scotch coast a similar station has been erected after the drawings and notes furnished by the Dutch Society; the International Exhibition of Fish and Fisheries, this year held in Berlin, rewarded the practical side of the institution with a silver medal. Further particulars may be obtained from the Secretary of the Commission for the Zoological station."

DR. HERMANN MÜLLER'S long-promised work on Alpine Flowers is being printed, and will be published towards the end of the year.

MR. DANIEL GRANT has given notice that he will to-day ask the First Commissioner of Works whether he will take into his consideration the advisability of substituting the electric light for the purpose of illuminating the House in place of the gas now used in the roof.

THE annual exhibition of the Photographic Society at Pall Mall will open on Saturday, October 2, and close on November 13 Friday, September 24, is the last day on which pictures can be received.

THE *Times* Geneva correspondent writes under date June 20 that a remarkable electrical phenomenon occurred at Clarens on the afternoon of Thursday last. Heavy masses of rain-cloud hid from view the mountains which separate Fribourg from Montreux, but their summits were from time to time lit up by vivid flashes of lightning, and a heavy thunderstorm seemed to be raging in the valleys of the Avants and the Alliaz. No rain was falling near the lake, and the storm still appeared far off, when a tremendous peal of thunder shook the houses of Clarens and Tavel to their foundations. At the same instant a magnificent cherry-tree near the cemetery, measuring a metre in circumference, was struck by lightning. Some people who were working in a vineyard hard by saw the electric "fluid" play about a little girl who had been gathering cherries and was already 30 paces from the tree. She was literally folded in a sheet of fire. The vine-dressers fled in terror from the spot. In the cemetery six persons, separated into three groups, none of them within 250 paces of the cherry-tree, were enveloped in a luminous cloud. They felt as if they were being struck in the face with hailstones or fine gravel, and when they touched each other sparks of electricity passed from their finger-ends. At the same time a column of fire was seen to descend in the direction of Chatelard, and it is averred that the electric fluid could be distinctly heard as it ran from point to point of the iron railing of a vault in the cemetery. The strangest part of the story is that neither the little girl, the people in the cemetery, nor the vine-dressers appear to have been hurt; the only inconvenience complained of being an unpleasant sensation in the joints, as if they had been violently twisted, a sensation which was felt with more or less acuteness for a few hours after. The explanation of this phenomenon is probably to be found in Prof. Colladon's theory of the way in which lightning descends, as described in NATURE, vol. xxii. p. 65. The Professor contends that it falls in a shower, not in a perpendicular flash, and that it runs along ranches of trees until it is all gathered in the trunk, which it u sts or tears open in its effort to reach the ground. In the instance in question the trunk of the cherry-tree is as completely shivered as if it had been exploded by a charge of dynamite.

THE number of lions in Algeria is fast diminishing, and it is expected that the animal will soon be extirpated from the colony. As there is an increasing demand for public exhibitions at fairs and zoological gard ns, an establishment has been formed at Bona, by a private individual, for lion-breeding.

The Commission for the construction of the Trans-Saharan Railway has determined that this great work shall be preceded by the establishment of a telegraph line connecting Algiers with St. Louis in Sengal *vid* Timbuctoo.

WE hear that Mr. J. R. Gregory, the well-known mineral dealer in London, has been awarded at the Sydney Exhibition a *first class*—equal to a gold medal—and a *third class*, for his collections of minerals and fossils, and geological collections.

WE are asked to state that the business of Messrs. R. and J. Beck, the manufacturing opticians, has been removed from No. 31, Cornhill, to No. 68, Cornhill.

THE success achieved by M. Paul Desmarets in his balloon photographs, to which we referred last week, has created some sensation in the scientific world of Paris. The photographs obtained by him at Rouen were exhibited and explained by M. de Fonvielle in a lecture delivered at Versailles Mairie on June 22, at a sitting of the Société des Sciences Naturelles. They have been presented by MM. Paul Desmarets and Jovis to the Minister of War; M. Janssen will present them at the Academy of Sciences, and M. W. de Fonvielle to the Geographical Society. One of the photographs will be published next Saturday in the *Monde Illustré*, having been photographed on wood and engraved. The electrical apparatus which enabled M. Paul Desmarets to obtain his *clichés*, and the obturators have a weight of 700 grammes only, including the elements required. Steps are being taken for the systematic photographing of Paris and vicinity. One plate shows a piece of land covered with houses, gardens, and roads in the vicinity of Rouen, measuring 300 yards by 300 yards, and executed on the scale of $\frac{1}{500}$. The altitude was about 1,100 metres. The second photograph was in the direction of W.N.W., facing the horizon. All the Seine, from Rouen Railway Bridge to Guelleboeuf, is seen with wonderful distinctness. The city of Rouen was concealed by a dense cloud, and is lost in darkness. The details on the banks can be magnified and examined at leisure. This remarkable ascent was made from Rouen on June 14, with *Gabriel*, a new balloon of 1,200 cubic metres belonging to M. Tovis, and built for the express purpose of crossing the Channel, weather permitting. It is owing to the uncertainty of the weather that this enterprise, of which we have spoken already, has been postponed.

WE learn from a circular forwarded to us that the Epping Forest and County of Essex Naturalists' Field Club will hold their next Field Meeting on Saturday afternoon, July 3, for the purpose of thoroughly inspecting the ancient earthworks of Ambresbury Banks and Loughton. The archæological conductor for the occasion is Major-General Pitt-Rivers, F.R.S.

M. TESSIE DU MOTAY, a French chemist who had invented a continuous process for the preparation of oxygen gas and apparatus for oxyhydric lighting, has recently died at New York at the age of sixty-two.

THE excursions arranged for by the Geologists' Association are to Maidstone on July 10, Leith Hill and Dorking July 24, and Bristol on August 16 and five following days.

ON Tuesday evening Signor Alberto B. Bach gave an interesting lecture at the Royal Academy of Music on the cultivation of the voice, and on his invention, the Resonator, an instrument somewhat of the nature of an artificial palate, intended to increase the power of the voice without any additional expenditure of breath. We hope to be able to give some further notice of this important invention next week.

NATURAL caverns of enormous size—one being 600 feet long—have been discovered within the last few days in the neighbourhood of West Harptree, near Wells, in Somerset. The investigations are still being carried on, and the discoveries have excited some interest among antiquaries and archæologists.

In a paper read at the last meeting of the Statistical Society, by Mr. R. Price Williams, C.E., "On the Increase of Population in England and Wales," the author said the total increase of the population of England and Wales during the whole of the last century was only 3,417,536, the average decennial rate of increase being nearly 5 per cent., whereas during the present century, up to 1871, there was an increase of nearly 14 millions, the average decennial rate of increase being over 14 per cent. The rate of increase in the decade 1811-21 was the maximum attained in this century, viz., 18 per cent., as from that period down to the census of 1861 the rate of increase of the population had continuously diminished. He observed that a great increase of the population took place at the time when steam-power began to be used for manufacturing purposes, and while the towns increased, the rural districts were found to diminish. Mr. Williams estimates that the population of England and Wales by the census of 1881, will be 25,735,900. In the case of the population of London the decrements were very slight indeed, showing that it had not reached that declining stage in the rate of its increase long since arrived at in the case of Liverpool, Manchester, and many other large towns. The population of London had increased from 958,863 in 1801 to 3,251,913 in 1871. He did not think there was sufficient data for estimating the future increase of the population of London for any lengthened period, and he regarded as unreliable the enormous estimates which had recently appeared in connection with the question of the water supply of the metropolis, where the population in the course of the next century was estimated at over 17 millions.

The Thirteenth Annual *Report* of the Peabody Institute of Baltimore testifies to the increasing usefulness of that institution, both as a library and as a centre of varied instruction. Among its means of usefulness are a series of lectures, many of which are on scientific subjects.

We have received the *Report* of the South African Museum for 1879, from which we are pleased to see that the Museum is in a fairly flourishing condition. A long list of additions during the year is appended.

The May and June numbers of the Friends' Schools' *Natural History Journal* contain much interesting matter, the local papers being specially valuable.

The additions to the Zoological Society's Gardens during the past week include an Arabian Gazelle (*Gazella arabica*) from Arabia, presented by Capt. Titus; a Common Genet (*Genetta vulgaris*), South European, presented by Mr. G. H. Thunder, R.N.; an Emu (*Dromæus novæ-hollandiæ*) from Australia, presented by Mr. A. McIlwraith, F.Z.S.; a Greater White-crested Cockatoo (*Cacatua cristata*) from Moluccas, presented by Mrs. A. L. Chetwode; three Red-beaked Weaver Birds (*Quelea sanguinirostris*) from West Africa, presented by the Marchioness of Westminster; a Crested Ground Parrakeet (*Calopsitta novæ-hollandiæ*) from Australia, presented by Miss M. S. Spooner; a Barbary Ape (*Macacus inuus*) from North Africa, an Ocellated Monitor (*Monitor ocellata*) from West Africa, deposited; three Ruddy Sheldrakes (*Tadorna rutila*), European, two Sandwich Island Geese (*Bernicla sandvicensis*) from the Sandwich Islands, two Blood-rumped Parrakeets (*Psephotus hæmatonotus*) from Australia, two Celebean Rails (*Rallus celebensis*) from Celebes, purchased; a Collared Fruit Bat (*Cynonycteris collaris*), a Japanese Deer (*Cervus sika*), born in the Gardens.

OUR ASTRONOMICAL COLUMN

The Third Comet of 1822.—Neither Galle in his catalogue, nor Karl in his *Repertorium der Cometen-Astronomie*, refers to any observations of this comet except the imperfect ones made by Caturegli at Bologna, and two by Gambart at Marseilles, and the only orbits found in the catalogues are the two calculated by Heiligenstein. The comet was however observed at Rio de Janeiro, from June 18 to June 24, and Henderson reduced the observations, which were made by Lieut. Robertson, R.N., and calculated an approximate orbit upon them. The comet approached near to the earth, and is of some interest upon that account. Mr. Hind has combined the observations of both hemispheres, and with the following results for the elements of the orbit: Henderson's numbers, not being found in our catalogues, are annexed:—

	Hind.	Henderson.
Perihelion passage	July 15·8442 G.M.T.	... July 15·651 G.M.T.
Long. of perihelion	219° 59′ 4″	... 220° 19′ 49″
,, Ascending node	97 44 3	... 98 14 47
Inclination of orbit	36 17 5	... 35 36 0
Log. perihelion distance ...	9·92797	... 9·92879
Motion—retrograde.		

Henderson's paper upon this comet will be found in the *Philosophical Transactions* for 1831. On June 18 the comet was in opposition to the sun, distant from the earth 0·14. Though it was discovered by Pons at Marlia on May 30, we have no observation previous to June 8. Pons at the time was not provided with instruments competent to fix the positions. Zach writes of the comet at the time of discovery that it was without tail or nucleus, simply a nebulosity more condensed towards the centre. Pons thought that in the absence of moonlight it would have been visible without the telescope. He was then on the watch for Encke's comet, which, though not observed in Europe, was closely followed by Rümker at Paramatta, N.S.W.

The Double-star 85 Pegasi.—Mr. Burnham publishes measures of the small and close companion of this star made in the summer of 1879, which, compared with those he obtained the previous year when he detected this very faint object, establish its physical relation to the principal star, since it is shown to partake of its large proper motion, while a suspicious difference of 10° between the means of the measures in 1878 and 1879 points to its binary character. These means are as follow:—

1878·43 ...	Position	274°·0 ...	Distance	0″·67 ... 3 nights
1879·46 ...	,,	284·6 ...	,,	0·75 ... 5 nights

Mr. Burnham estimates the magnitude of the close companion about the twelfth on Struve's scale, and considers it will require an aperture of at least twelve inches to show it. He has also measured the distant companion which was used by Prof. Brünnow in his investigation of the parallax of 85 Pegasi, which he made to be 0″·054. This star was observed with 85 at Königsberg by Bessel on October 6, 1825, when it followed 61″·95 in R.A., and was 38″·6 south of the bright star. If we compare these differences with those corresponding to Mr. Burnham's measures at the epoch 1878·95, and assume the fixity of the companion, we shall find for the secular proper motion of 85 Pegasi in R.A. + 100″·1, and in Decl. − 96″·1, agreeing precisely with the values resulting from a comparison of the meridian observations. If, as Prof. Brünnow hinted, there is proper motion of the distant companion, its amount would appear to be very minute. Mr. Burnham adds that there are but two other stars on our lists similar in character to 85 Pegasi, viz., η Piscium and β Scorpii; all three were detected by him with the 18-inch Chicago refractor.

A Variable Star in Aquarius.—The star observed on six nights at Bonn, in 1863, in R.A. 22h. 28m. 16·9s. N.P.D. 98° 21′ 19″ for 1855·0, is variable from 9m. to invisibility in a 7-inch aperture. Argelander noted it four times 9·5, once 9·6, and once 10·0. It was observed at Markree as a 9m. on October 27, 1848, on August 26, 1852, it was 11m., and on November 9, 1874, it was invisible. On September 21, 1876, it was 11·12. It has at times a hazy blurred appearance, as remarked in several other variable stars. This star was long since indicated as variable, but appears to have escaped attention from most observers of this class of objects.

GEOGRAPHICAL NOTES

Dr. Francisco Perreira Passos, Director of the Brazilian State Railways, has recently caused to be prepared and published a map showing the existing and projected railways in the provinces of Rio de Janeiro, Minas, and San Paulo. This map is

apparently executed with much care, and is stated to be the most accurate of its kind yet produced in Brazil. He has also published the first part of a work on the railways of Brazil in 1879, descriptive of the lines shown on the above-mentioned map, and he has added a skeleton map showing the railways only. Dr. Passos has, we believe, been induced to issue these publications in order to make more widely known in England the progress in railway communication now going on in Brazil, a subject which is of considerable interest from an economical and geographical point of view.

THE last *Bulletin* of the Antwerp Geographical Society contains a geographical and commercial essay on the Australian colonies, which is accompanied by reproductions of some curious old maps, as well as by a sketch map which professes to distinguish the arable, pastoral, and desert regions of the continent, in regard to which, however, the writer's information hardly appears to be brought down to the latest date.

FROM the Japan papers we learn that H.M.'s surveying vessel *Sylvia* left Hiogo on April 24 for Cape Chichakoff to take a line of soundings there, which will complete her surveying work on the Japanese coast. The *Sylvia* has been employed for about twelve years in surveying the coasts of Japan and the Inland Sea, and during this period has done excellent service to navigation.

M. DE UJFALVY is to leave Paris at the end of the summer on his new journey of exploration in Central Asia.

THE *Times* correspondent writes from Copenhagen that on June 24 died there Mr. Carl Petersen, whose name is connected with some of the most renowned Arctic explorations. He was a born Dane, but had lived many years in Greenland, and had there acquired a perfect knowledge of the Esquimaux language, being at the same time a most skilled hunter and fisherman. At the age of thirty-seven he was engaged by Capt. Penny as interpreter, and accompanied his expedition in the years 1850-51. Some years later he followed Dr. Kane on his unfortunate expedition, when the vessel had to be left in the ice and the crew were nearly starved and frozen to death. He had not been home more than a couple of weeks after returning from a two years' stay in Greenland, before he went out again as interpreter with the *Fox*, Capt. Sir Leopold M'Clintock, with Mr. (now Sir) Allan Young as sailing master. Of this expedition, lasting from 1857 to 1859, and leading to the discovery of the fate of Sir John Franklin, he has written a graphic description, supplying many details wanting in the well-known book of Sir L. M'Clintock, and inscribed with the words chosen by Jane Franklin for the flag of the *Fox*, "Hold fast," happening to be quite as correct in Danish as in English. In 1861 he accompanied the Swedish naturalists Nordenskjöld and Torell on their first expedition to Spitzbergen, and when, in last April, the *Vega* passed Copenhagen, the hardy old sportsman and sailor, with his cross and Arctic medal, was one of the friendly faces greeting the discoverer of the North-East Passage. Mr. Petersen died from heart-disease at the age of sixty-seven.

PHYSICAL NOTES

ONE of our electrical contemporaries across the Channel gives a glowing description of *une grande machine électrique allemande*, which its editor says he wishes to see introduced into France, "where our official professors appear to have lost all ambition at making things big." The great gooseberry of the season is nothing to this new machine, which is, we are told, composed of twenty parallel disks of 1,300 metres in radius. This is "making things big" with a vengeance, for the diameter of the disks will be over 2½ kilometres, or about a mile and a half. Did our contemporary make a double blunder when it wrote "*treize cents mètres*"? If we remember rightly, the plates in Töpler's induction-machine, which appears to be the one referred to, are not far from 13 centimetres radius.

PROFESSORS BRACKETT AND YOUNG have made a new determination of the efficiency of Edison's dynamo-electric generator and of his carbon horse-shoe lamp, and find that one horse-power applied at the dynanometer would produce in this lamp a light equal to that of 107 standard candles. As a matter of fact the lamp was only giving a light of 10·7 candles while consuming 0·077 of a horse-power, which is not quite the same thing.

PROF. QUINCKE has lately been occupied with a very remarkable research on the alteration of volume which a dielectric experiences under the stress of an electric charge. In most cases the result of surface electrification is to produce a minute expansion, but one class of bodies—that of the fatty oils and resins—contracts under similar circumstances. Herr Quincke applies his measurements to explain the phenomena observed by Kerr of the double refraction of light exhibited by dielectric media when under electrostatic strain; and he shows that the optical effects in the two classes of media are opposite in character.

M. MOUCHET is continuing in Algeria the researches on the utilisation of solar heat which he began in the South of France. He employs, according to his recent communication to the *Comptes Rendus*, a mirror 3·8 metres in diameter to concentrate the rays of the sun upon a boiler of copper 5 millims. thick. Even on dull days the apparatus boils water under half an hour. M. Mouchet has employed his apparatus for the distillation of oils and essences, the boiling of linseed oil, and the sublimation of benzoic acid. He has even succeeded in working a small engine.

MR. G. R. CAREY of Boston has published in the *Scientific American* a suggested system for the transmission of light by electricity. A camera throws an image of the object to be exhibited upon a surface made up of small pieces of selenium, each of which forms part of a separate voltaic circuit, the circuits passing to a receiving instrument, where they reproduce the image by incandescence. To this Mr. Sawyer has appended the following criticisms:—The action of light in altering the conductivity of selenium is slow. To transmit satisfactorily an image one inch square would require 10,000 selenium points and 10,000 conducting wires, unless some principle of isochronous movement could be devised—which Mr. Sawyer regards as unattainable in practice.

M. FAYE has lately published in the *Comptes Rendus* a remarkable paper on the physical forces which have produced the present figure of the earth. After remarking on the use of the pendulum in determining the figure of the earth from series of measurements of the intensity and direction of the gravitation force at different parts of the earth's surface, he draws attention to the curious fact that while the direction and intensity of gravity are affected perceptibly by the presence of hills such as Schiehallion and Arthur's Seat, or even by masses as small as the Great Pyramid of Gizeh, gigantic mountains such as the Himalayas, and great elevated plateaux and table-lands do not affect the pendulum-indications in any sensible manner, except in certain cases where upon elevated continents there appears to be a veritable defect of attraction instead of the excess which might be expected. Indeed, the observations are sufficiently striking to seem to point to the supposition that not only under every great mountain, but even under the whole of every large continent, there were enormous cavities. More than this, the attraction at the surface of all the great oceans appear too great to agree with the distribution presumed by Clairant's formula, which is exact enough for most purposes. Sir G. Airy's suggestion that the base of the Himalaya range reaches down into the denser liquid interior, and there displaces a certain amount of that liquid, so that the exterior attraction is thereby lessened, is one which, inherently improbable, fails to have any application in explaining why the attraction above the seas should be greater than over the continents. M. Faye propounds the following solution to the difficulty:—*Under the oceans the globe cools more rapidly and to a greater depth than beneath the surface of the continents.* At a depth of 4,000 metres the ocean will still have a temperature not remote from 0° C., while at a similar depth beneath the earth's crust the temperature would be not far from 150° C. (allowing 33 metres in depth down for an increase of 1° in the internal temperature). If the earth had but one uniform rate of cooling all over it, it would be reasonable to assume that the solidified crust would have the same thickness and the same average density all over it. It is therefore argued that below the primitive oceans the earth's crust assumed a definite solid thickness before the continents, and that in contracting, these thicker portions exercised a pressure upon the fluid nucleus tending to elevate still further the continents. This hypothesis, M. Faye thinks, will moreover explain the unequal distribution of land and sea around the two poles; the general rise and fall of continents being determined by the excess of density of the crust below the oceans, and by the lines or points of least resistance to internal pressure being at the middle of continents or at the margin of the oceans.

SOME experiments have lately been made by the Rev. Dr. Haughton and Prof. Emerson Reynolds to evaluate the coefficient of friction (*i.e.* the "drag") of air upon air and of water upon water. In these experiments a spherical ball of unpolished granite of 22 kilogrammes weight and 25 centimetres in diameter was suspended freely by a pianoforte wire and was set rotating in the air or in water; the period of the vibrations and the decrement of their amplitudes being observed by means of indices attached to the brass collar by which the ball was suspended. A discussion of the equations of motion led to a simple working equation for reduction of results. The mean coefficient of friction found for air upon air was $f = \frac{1}{6052 \cdot 7}$, though this value apparently differed slightly according to barometric and thermometric conditions. For the "drag" of water upon water the value found was $f = \frac{1}{307}$. These experiments involved friction at low velocities only, for which it could be assumed that the friction was proportional to the velocity. The authors of this research point out that these results tend to negative the theory of Dr. Carpenter that the phenomena of ocean circulation are due to the greater height of the water at the equator as compared with that at the poles.

FROM a series of experiments with tones produced by a limited number of impulses, Herr Kohlrausch finds (*Wied. Ann.*, No. 5) that a tone of only two vibrations of a certain frequency can be distinguished as differing in pitch from a continuous tone, when it forms with it an interval of $\frac{31}{32}$. Also, in agreement with the researches of Herr Exner and Herr Auerbach, the possible sharpness in definition of the pitch of a tone by an ear of average fineness does not perceptibly increase after sixteen vibrations have occurred. The general results are regarded as confirming Helmholtz's theory of the co-vibration of tone-perceiving organs in the ear. The experiments were made with a pendulum fitted with a piece of toothed wheel, of radius equal to the length of the pendulum, the teeth impinging on a piece of cardboard. The continuous tone was obtained from a monochord.

THE torsion of wires of steel, iron, and copper has been recently made a subject of experiment by Herr Warburg (*Wied. Ann.*, No 5). Among other results, the statically-determined moments of torsion are found to be all smaller than those dynamically determined; and the differences rise from 1 per 1,000 for steel to 6 for iron and 28 for copper. The elastic pressures seem to increase somewhat more slowly than the deformations, the divergence being greater for copper than for iron, and for iron than for steel. No dependence of the coefficients of torsion on the tension was discoverable (within the limits of experiment). As to the properties of wires that have undergone permanent torsion, it appeared that it was only in the case of soft copper wires that, within wide limits of permanent torsion, these extend almost uniformly over the whole wire. Confining himself to copper wire, then, his experiments lead him to believe that by permanent torsion the wire becomes anisotropic, behaving, at any part, like a crystal of the rhombic system, whose axes have certain directions.

ATTENTION has been called by Herr Holtz (*Wied. Ann.*, No. 5) to an optical illusion in looking at geometrical figures, whereby they appear shorter from right to left than they really are; a square, *e.g.*, appearing more or less as a rectangle, and a circle as an ellipse. One direct consequence is that when we draw such figures according to eye-measurement, we make them too long horizontally. The reason of the illusion Herr Holtz considers to be that, in common life, we much more frequently encounter bodies than geometrical figures, and so are disposed to accept the outlines of such figures for the outlines of actual bodies. Now we see more of a body in a horizontal direction than in a vertical, because we see with two eyes, and these are in a horizontal line. The outline of a ball appears to us really as an ellipse, because, from right to left, we see more than half of the ball. When we see a true circle this seems horizontally shortened, because we take it for the outline of a ball, and if we draw a circle we unconsciously give the outline of a ball.

SOME researches by Herr Röntgen in the same line as those by Dr. Kerr, revealing a new relation between light and electricity, are described in the *Annalen der Physik*, No. 5; the methods were somewhat varied. Special attention was given to the direction of vibration of the light in the liquid, and the author's results seem in the main to confirm Dr. Kerr's views. Dr. Kerr got an effect with nitro-benzol only when a spark-interval was introduced in the connection of the one electrode with the conductor of the machine, giving a sudden discharge through the liquid. This Herr Röntgen considers due to the comparatively good conductivity of nitro-benzol; the spark discharge effects a brief but large difference of potential (not obtained in the other case), producing sudden luminosity in the field of vision. But Herr Röntgen obtained the same effect with all the badly-conducting substances he examined; it was only of longer duration. A welcome method is thus afforded for examining comparatively good conducting liquids as to electro-optic properties, and Herr Röntgen thus demonstrated, for glycerin, sulphuric ether, and distilled water, an influence of electricity on the transmitted light. The author offers (doubtfully) a different hypothesis of the phenomena to that of a direct action of electricity on the light vibration.

IN a recent paper in the *Annalen der Physik*, No. 5, Prof. Clausius criticises recently-published views of Maxwell, Frowein, and Korteweg on the mean length of path of gas molecules.

PHYSICAL SCIENCE IN RUSSIA

WE have before us the minutes of the meetings of the Physical Section during the last congress of Russian naturalists, just published in the last number of the *Journal* of the Russian Physical and Chemical Society (vol. xii., fasc. 4), and we find in them reports of several very interesting papers which were read and discussed during the congress.

The most numerous communications were on electricity. Thus, M. Feploff exhibited the new electrophoric machines of his invention. A glass of sulphuric acid is sufficient for maintaining the machine ready, even during moist weather; it gives very powerful sparks, white and coloured, and succeeds well in decomposing water.—Prof. Khvolson made a communication on corrections to the differential equations of the motion of a magnet which oscillates under the influence of a metallic tranquilliser, and discussed the method of computation of corrections to differential equations of motion in general.—M. Tchikoleff gives the equations for determining the losses which an electrical current experiences when passing through telegraphic wires.—Prof. Stoletoff has terminated his experiments for determining the ratio between electro-magnetic and electro-static units (v of Maxwell). He undertook his experiments in 1876, but had not terminated them at that time; recently MM. Ayrton and Perry have determined the value of v by a method analogous to his own, which differs from theirs in measuring a current produced by a series of successive discharges, by means of a rotating commutator, the velocity of rotation of which is measured by means of a chronograph. The preliminary experiments have given a velocity very near to that found by other researches, *i.e.*, about 300,000 kilometres per second, and Prof. Stoletoff expects to obtain more exact figures.—M. Borgmann continues his experiments for determining the heating of iron by intermittent magnetisation. The experiments are very difficult, because of the inductive currents, but they have already shown that a change in the magnetic state produces an increase of temperature.—Prof. Lemström (Helsingfors) made a communication on his most important work on the causes of terrestrial magnetism. He has demonstrated that an annular isolator, when put in rapid rotation around an iron cylinder, acts upon this last as a galvanic current and magnetises it. Likewise an iron cylinder when rapidly rotating in an insulating medium must be magnetised, and thus the earth when rotating in an atmosphere of ether must also be magnetised. The various peculiarities observed as to terrestrial magnetism might be easily explained by the motion of the earth around the sun, and by the terrestrial galvanic currents.—M. Tchikoleff explained his improvements in the Foucault electric lamp, which allow several lamps to be placed in one circuit.—Prof. Petrushevsky made an interesting communication on his measurements of the intensity of the magnetic field between the extremities of electro-magnets of various shapes, which measurements were made for determining the best shape to give to electro-magnets. That of Ruhmkorff proved to be twice as strong as that of Gramme. The best shape is that of two iron cylinders united together by means of arcs made of broad iron plates. The free ends must be provided with two spherical pole-pieces, each of which has a conical processes, the ends of these two processes being directed one to another.

In meteorology we notice several valuable papers, the most important of them being that by M. Woeikoff on rainfall in

various parts of the earth within different seasons.—Prof. Krayevitch, who has undertaken a series of investigations on the very small changes of pressure of the air in connection with changes of weather, exhibited his new graphic very sensitive barometer, the column of which consists of water and mercury, and which amplifies 140 times the oscillations of a common mercury barometer.—Prof. Egoroff has begun a series of researches into the atmospherical lines of the solar spectrum. As known, several of them are due to the presence of water-dust in the atmosphere, and Ångström supposed that several other lines (A, B, and *a*) depend upon the presence of carbonic acid and nitrogen. The experiments of M. Egoroff show that neither of these two gases modifies the solar spectrum, even when the rays go through a sheet five metres thick of gas.

In other branches of physics we must but notice the most important work, by Prof. Tchebysheff, on centrifugal regulators; the researches by M. Sloughinoff on the calorific capacity of gases; by Prof. Petrushevsky on the velocity of evaporation of liquids with reference to the coefficients of cohesion of these liquids and to the molecular pressure; on the true atomical heat capacity, by M. Stelson, who arrives at the conclusion that the theory of a constant atomic heat-capacity is not true for many gases; and by M. Sloughinoff, on the powder-state of bodies, and on the changes of the internal energy of solids and fluids under the influence of exterior forces.

We notice also the communication by M. Lebedzinsky on an improved microscope with liquid lenses, which gives enlargements from 50 to 200 times, and is very cheap; and by M. Argamakoff on lighting and heating by means of pulverised hydrocarbons.

SEISMOLOGY IN JAPAN

The Earthquake of February 22, 1880.—The earthquake which occurred shortly after midnight on the morning of February 22 was the most severe since the opening of this country to foreigners. I have been so much in the habit of noting my watch during the frequent earthquake manifestations by day and night, that I am sure I must have been instantly awakened. My house was swaying to and fro, windows were rattling, timbers creaking, mortar falling, and pictures swinging violently. Although, as usual on such occasions, I was studying my watch by a night light, I meditated escape. After forty seconds the motion apparently subsided. There had been two distinct periods of maximum intensity. Taking my lamp, I tried to reach the door, but the motion was still so great that I had to stop, supporting myself against the wall. When I went down stairs to look at two long pendulums of 20 and 30 feet length respectively, I found them swinging in arcs of about 2 feet, having broken all the apparatus on the table over which they hung. Hitherto the pointers placed on heavy weights suspended by long wires have been regarded by me as motionless points during an earthquake, and I have been able to use them accurately on this assumption even for a shock which Palmieri's instrument indicates as 21°, a shock which knocked down several chimneys. It would seem that in the last earthquake the house, instead of, so to speak, "eating up" the vibrations, was forced into vibration itself. The period of this vibration was roughly noted by my neighbour, Mr. Thomas Gray, as nearly one second. At the lower end of one of these pendulums I have small pointers which scratch two smoked glass plates. These plates are caused to move away during an earthquake, so that relative vibrations are shown in two wavy lines. The direction of the first mark upon the plate tells the direction of the shock, and also the distance moved by the earth relatively to the steady pointer. The amplitude of the waves tells approximately what the movement has been during succeeding vibrations. From the number of waves upon a given length of glass we get the rate of vibration, and hence, knowing the velocity of transit, the true wave-length of the earthquake may be determined. As an example I may mention that an earthquake (December 3, 1879) registered by Palmieri's instrument as 18°, was recorded on 7 inches of one of my glass plates in a curve of seven very small waves, the amplitude of each of which was about 1 mm. Each wave was formed in half-a-second. The important deductions which may be drawn from even only one observation of this kind are obvious. The other pendulum I have used only for finding the greatest horizontal movement of an earth particle and its direction. Two pointers push against the motionless pendulum-bob when an earthquake occurs, and so they are moved in the stand which carries them, deflecting two suspended galvanometer mirrors, and readings of the amount of deviation of beams of reflected light are taken. I give some examples of the movement of the head of a pile which was driven deeply into the soft soil upon which Yedo is built:—

1. March 4, 1879, 4.43 p.m.—On the smoked glass the mark made was 3 mm. long; N. 10° E. to S. 10° W. Palmieri's instrument gives this shock of intensity 10° from S.S.W. to N.N.E.

2. February 1, 1880.—Small shock. Mark 1·25 mm. from N. 35° W. to S. 35° E. Palmieri's instrument gives intensity 2°·5 S.S.E. to N.N.W. As measured by the mirrors, this shock was 0·5 mm., and there is reason to believe that the mirrors were more correct. The amplitude of swing, as indicated on the moving plates, was from 3 mm. to 4 mm. At the point, however, there seems to have been a motion of about 10 mm.

As my indicating apparatus was broken, I give the following record from two of Palmieri's instruments in the Government Observatory:—

From	S.S.E.	or N.N.W.	the intensity was	78
,,	S.S.W.	,, N.N.E.	,, ,,	52
,,	W.S.W.	,, E.N.E.	,, ,,	28
,,	W.N.W.	,, E.S.E.	,, ,,	28

These measurements had to be computed, as the graduations of the instruments are only to 26°. The shaking seems to have had three periods. The first began at 12h. 49m. 22s., and lasted 14 seconds; the second began at 12h. 50m. 19s., and lasted 1m. 26s.; the third began at 12h. 52m. 15s., and lasted 6 seconds.

On visiting Yokohama I found that the chief destruction had been amongst the houses belonging to Europeans. This is partly due to the Japanese houses being nearly as flexible as baskets, but it is also on account of the European houses being mostly buils on hills. Thus the houses built on the *bluff*, hills intersected by sharp steep valleys, and also many houses built along the *creek* have suffered; the greater part of Yokohama is built on a plain of shingle, and the houses here escaped with small damage.

The edge of a declivity is like the last of Tyndall's row of boys, unsupported on one side, and therefore gets shot forwards.

Tokei, Yokohama, Japan JOHN MILNE

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

CAMBRIDGE.—In the first half of the winter course of lectures given in connection with the Cambridge Local Lectures the attendance of about 1,200 persons, on subjects of physical science, out of a total of 3,570, may be noted. In the second half of the session scarcely 400 were attending lectures on physical science subjects, but this was coincident with a general falling off after Christmas, to which bad weather, depression of trade, and political excitement may have contributed.

Another academic year has completely passed, and in the multitude of counsellors no relief has yet been given to those who desire freedom of choice of language studies and some chance for modern languages. The University still says: "If you have not the smattering of Greek we require, we will give you no degree unless you bring up Arabic or Sanskrit as an Oriental student."

A LIVERPOOL paper intimates that the movement for establishing a University College in that city is likely soon to be crowned with success. In the scheme which was approved at a town's meeting held some months ago it was proposed that seven professorships and two lectureships should be founded, and it was estimated that, independent of the cost of erecting college buildings, the amount required for the foundation of the college is an annual income of 3,000*l.*, or a capital sum of 75,000*l.* The committee accordingly appealed for subscriptions, and the appeal has been responded to in such a hearty manner that there is every probability of the entire sum required being raised before long. Already 60,000*l.* has been subscribed for the establishment of the college, the subscriptions including several of 10,000*l.* each. Lord Derby has subscribed 10,000*l.* towards the founding of one professorship; a like sum has been given by Messrs. W., S. G., and P. H. Rathbone. Mrs. Grant of Rock Ferry has endowed another professorship with 10,000*l.*; Col. A. H. Brown and the Messrs. Crossfield have between them contributed 10,000*l.* for the founding of another chair; and it is believed a number of Scotchmen resident in the city will provide

a similar amount for a similar purpose. Several other large subscriptions have been promised to the treasurer, Mr. Robert Gladstone, bringing the total up to the amount above stated.

SCIENTIFIC SERIALS

Bulletins de la Société d'Anthropologie de Paris, tome 2, fasc. 4, 1879.—This closing number of the last year's Bulletins contains an interesting paper by M. Jacques Bertillon on the mean averages of life in the various grades of society among civilised races. His paper refers specially to France, although it supplies some comparative tables deduced from the mortality tables of other countries, while it principally aims at directing attention to the preventibility of numerous causes of early death.—M. G. Lagneau, in presenting to the Society the mortality tables for Belgium, drawn up by Dr. Janssens for 1878, referred to the predominance of phthisis in male subjects in France since 1865–66, females having before that period supplied the larger number of deaths from pulmonary tuberculosis.—M. Lunier records the results of the official inquiry which he had been authorised to make in reference to the distribution of epilepsy in the various departments of France, and with regard to station, age, sex, &c.—M. le Docteur G. Le Bon gives an interesting report of his examination of the curious collection of skulls of celebrated men, now in the possession of the Paris Museum of Natural History, which is believed to include those of Boileau, Descartes, and Gall. The mean cranial capacity for the forty-two skulls, when compared with that of forty-two skulls of modern educated Parisians, was in excess of the difference between the latter and an equal number of negroes.—The present number of the *Bulletins* contributes little of importance to the literature of local French palæontology, the most interesting of such contributions being a paper by M. Mortillet, who reports the discovery, by M. Perron, of a funereal car with traces of human bones and textile fabrics in the tumulus, or barrow, known as la Motte at Apremont, in Haute-Saône.—M. Verneau describes the Grotto de Voutré, in La Mayenne, in which a skeleton, believed to belong to the Bronze age, has been found, while a similar discovery has been made at Quevilly, near Rouen, as also at Cierges, where fragments of a dolichocephalic cranium of the neolithic type have been recovered. M. Millescamps has, moreover, drawn attention to the recent discovery by the Abbé Hamard, at Hermes (Oise) of cut flints in graves of the Merovingian age. The previous discovery between 1873 and 1875 of upwards of 20,000 flints in the Merovingian cemetery of Caranda has raised the question, which still awaits solution, whether these flints were deposited with the dead merely as objects with which the living had been most familiar, or whether their presence had any supposed protective action.—M. Zaborowski has laid before the Society the result of his examination of five Hakka skulls, and communicated the information he had received from M. de Lagrenée, French Consul at Canton, in regard to the history and pure Chinese origin of the Hakkas, who have in all ages formed the active combative element in the Chinese system, and have in recent years constituted the kernel of the Taïping rebellion.—The Abbé Durand describes a blonde African race, noticed near Laouga in 1562, and still traceable in Mozambique.—The original site of the Aryan race has again been brought under discussion by M. Henri Martin, who now inclines to the opinion, supported by M. de Ujfalvy, that a brown brachycephalic Aryan branch took precedence in Asia of the blonde dolichocephalic Aryans.—The most important paper in the present volume is M. Paul Broca's "Etude des Variations craniométriques, et de leur Influence sur les moyennes." To this is appended a valuable series of the means, variations, &c., of the cranial measurement of heads belonging to all countries and various periods.—M. Ujfalvy explained his views in regard to the opinion put forth by the Swedish anthropologist, Prof. G. Retzius, that Finland is occupied by two distinct races, the true Fin, or Tawaste, and the Carelian, or Finlander.—M. Emile Soldi, in presenting to the Society his recent work on the proportions of Greek and Egyptian statues, took occasion to refute the opinion advocated by Dr. Le Bon and M. Broca, that the Greeks followed Egyptian canons of taste in art, and that they took their models from foreigners.—M. Bataillard read a paper on the ancient workers in metals in Greece, and endeavours to trace in the tinsmiths of Dodona the direct ancestors of the modern Tsiganes, or gipsies.

Papers and Proceedings of the Royal Society of Tasmania for 1878.—R. M. Johnston, on the freshwater shells of Tasmania; gives a list and describes several new species.—Rev. J. E. Tenison-Woods, on some new Tasmanian marine shells; describes a new genus, Iosepha, for a Cominella with a plait, and several new species.—R. M. Johnston, on certain tertiary and post-tertiary deposits on islands in Bass's Strait.—F. M. Bailey, remarks on the distribution and growth of Queensland plants.—Rev. J. E. Tenison-Woods, on some Tasmanian freshwater univalves.—F. Abbott, on *Carduus arvensis*.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, June 10.—"On *Bacterium fatidum*: an Organism associated with Profuse Sweating from the Soles of the Feet." By George Thin, M.D. Communicated by Prof. Huxley, Sec.R.S.

The feet of certain individuals are characterised by a peculiar powerful and fœtid odour, which is really connected with the moisture that soaks the soles of the stockings and the inside of the boots. The moisture, which comes from the skin of the soles, especially from that of the heels, has no offensive smell whilst it is exuding, but it rapidly acquires the characteristic odour when taken up by the stocking.

The fluid is an admixture of sweat with serous exudation from the blood, occurring in persons whose feet sweat profusely, and who, from much standing or walking, acquire an erythematous or eczematous condition of the skin of the soles, the local eczema or erythema being favoured by the softening and macerating effect of the sweat on the epidermis.

When a small portion of the sole of the wet stocking was teased out in water, the drop of water was found to be swarming with micrococci.

A second generation of the organism, which the author calls *Bacterium fatidum*, was obtained by placing a small piece of the wet stocking in a test-glass, charged with pure vitreous humour. This and succeeding generations were cultivated at a temperature which varied between 94° and 98° F. The successive generations were obtained by inoculating pure vitreous humour, with requisite precautions.

In twenty-four hours the surface of the vitreous humour was always found covered with a delicate scum, which in forty-eight hours was compact and tolerably resistant.

In the scum of one day's growth and in the fluid below it organisms were found as cocci, single and in pairs, in transition stages towards rod formation, as single and jointed rods, and as elongated single rods. Many of the rods were actively motile.

The compact scum of two days' growth was sufficiently resistant to be removed in an unbroken sheet. When disturbed by the needle it fell to the bottom of the glass. It was found to contain all the forms found in the twenty-four hours' growth, and in addition long unbroken rods in transition stages towards the formation of chains of spores.

Spores were also found lying beside the empty and partially empty sheaths from which they had been discharged. Groups of single spores and pairs, identical in size and appearance with those which had come to maturity in the sheaths, were found mixed up with rods in all phases of development.

The first stage in the development of the organism is the formation of a pair from one coccus.

The next stage is that in which the whole body is wedge-shaped, the round brightly refractive coccus being found in the thick end of the wedge. Another phase, which is probably the successor of the preceding one, is the appearance of a canoe-shaped figure with the bright coccus in the centre.

Other appearances connected with the early stage of development, and probably following the wedge and canoe-shaped figures, show the organism developed into a staff-shaped body, containing two elements of very different refractive power. The coccus element is still distinct and is brightly refractive, the other element is very slightly refractive and is seen as a dull shade, with however perfectly distinct outlines.

The coccus may be at one end of the rod, two cocci may be in the centre close together with a prolongation of protoplasm on either side, or a central rod of protoplasm may have a coccus at either end.

In the next stage we have the formation of the rods characteristic of bacteria. The distinction between the coccus and the protoplasm becomes lost, although transitions are found in which faint differences of refraction still betray the two elements. The formation of rods of ordinary size, of long rods with

unbroken protoplasm, of rods with segmented protoplasm, and of rods filled with spores or cocci progresses identically with the similar formation in the *Bacillus anthracis*.

The bacterium grows in turnip infusion less actively than in vitreous humour. The observations were not sufficiently extended to determine whether the bacterium forms spores when cultivated in turnip infusion, but they sufficed to show that if such a formation takes place, it occurs much less actively than when the cultivation is in vitreous humour.

The fœtid odour of the stocking was reproduced in the cultivation glasses, although the strength of the odour diminished in successive generations.

Dr. Thin stated at the meeting that an antiseptic treatment by which the bacteria were killed in the stockings and inner surface of the soles of the boots completely destroyed the fœtor.

"Memoir on Abel's Theorem," by R. C. Rowe, Fellow of Trinity College, Cambridge. Communicated by A. Cayley, LL.D., F.R.S., Sadlerian Professor of Pure Mathematics in the University of Cambridge.

"On certain Effects of Stress on Soft Iron Wires," by J. A. Ewing, B.Sc., F.R.S.E., Professor of Mechanical Engineering in the University of Tokio, Japan. Communicated by Fleeming Jenkin, F.R.S., Professor of Civil Engineering in the University of Edinburgh.

Physical Society, June 12.—Mr. Huggins, F.R.S., in the chair.—New Members: Mr. H. B. Iuff, Mr. Adam Hilger, Mr. C. V. Boys.—Dr. Shettle, of Reading, read a paper on the influence of solar radiation on the earth's rotation. The fact established by Dr. Shettle, that the magnetic energy of a bar magnet acts along spiral lines has led him to surmise that the energy emanating from the sun and impinging on the earth on the zone of the ecliptic, traverses the earth in a spiral path and finally emerges at the magnetic poles. The spiral of energy is "right-handed" at one pole and "left-handed" at the other, like the magnetic force in a magnet and the electric discharge in Crookes' vacuum tubes. Like precession and nutation, these spiral paths are constantly changing and producing magnetic variations. He therefore infers that the magnetic poles will complete a cycle corresponding to the period of precession. Dr. Shettle thinks that bodies exhibit magnetic properties in proportion as they change the direction of the energy traversing them, and throw it into the spiral form. Terrestrial magnetism would be due to the solar radiance on this hypothesis. Gravity also would be produced; so likewise would the earth's rotation (by a kind of "magnetic whirl"), electricity, tornadoes, cyclones, water-spouts, and whirlwinds. Moreover this "spiral energy" would seem to operate throughout the whole universe.—Prof. Wiedemann, of Leipsic, made a communication on the phenomenon of interference in rays of long path, and showed how the phase of vibration of the atom or molecule emitting the rays influenced the phenomenon. Molecular collisions could operate in preventing interference. From a study of this question he was able to deduce a method of determining the pressure on the surface of the sun and stars. He mentioned that he had found that the temperature of a glowing gas in Geissler's tubes may be under 100° C., and therefore the light of the aurora or of comets might be accompanied by a low temperature. He had determined that the quantity of heat produced in a gas by the electric discharge was always the same, with the same amount of electricity, whether discharged at once or not, and that it increases nearly in proportion to the pressure of the gas. He had also determined that the heat which must be developed by a discharge in hydrogen in order to change the band spectrum of H into the line spectrum is about 100,000 calories for 1 gramme of hydrogen, and hence this might represent the amount of heat necessary to transform the hydrogen molecule into its atoms. Dr. Schuster suggested that Prof. Wiedemann should make a similar experiment with another gas, say nitrogen, as there was a disagreement about the spectra, and Prof. Wiedemann stated that he so intended.—Mr. Ridout exhibited a device for amplifying small motions. A small barrel is slung by two threads between the prongs of a metal fork in such a manner that if the fork is bodily carried to and fro the barrel will rotate round its axis. This is simply effected by making each thread, in its passage from one prong to the other, take a few turns round the barrel. To the barrel an index is attached, and the fork is then fixed on the body whose minute motion is to be indicated. The translation of the body shifts the fork and rotates the barrel, which in turn deflects the index round the face of a dial, and the magnifying power is expressed by the ratio of the diameter of the barrel to the length of the index. With this apparatus Mr. Ridout exhibited the lengthening of an iron core when magnetised by the passage of the current of two Grove's cells through an insulated wire coiled round it. By riveting a slip of brass to the iron, the unequal expansion of brass and iron under heat was also shown, the heat being generated by keeping the current flowing in the coil.—Mr. D. Winstanley exhibited his new radiograph for recording graphically the intensity of solar radiation throughout the day. It consists of a differential thermometer with one black bulb and a circular stem. The lower part of the stem is filled with mercury, the upper branches with sulphuric acid and water. The tube is mounted on a brass wheel, so that when the black bulb is exposed to the sun's rays the differential motion of the mercury causes the wheel to turn. The wheel carries a light index or marker, which is free to traverse a vertical cylinder covered with paper coated with lampblack, and leaves a white track where its point has scratched off the soot. The radiogram thus produced can be fixed and preserved. Dr. Guthrie pointed out the curious "thermal twilight" these radiograms had betrayed to Mr. Winstanley. They show that before sunrise the temperature increases, owing to solar radiation. Moreover, half an hour after sunset the index falls and remains till within a few minutes of midnight, when it mysteriously rises and sinks again, although the sun is then directly over the opposite hemisphere.—Mr. Baillie then gave the results of a study he had made into the theory of the phoneidoscope. He finds that waves simultaneously start from each side of the soap-film when the note is sounded, and meeting in the middle generate ventral points and notes. The equations of several cases were given by him, and he suggested that photography should be employed to fix the appearance of the figures, in order that they might be investigated theoretically.

Linnean Society, June 17.—Prof. Allman, F.R.S., president, in the chair.—Dr. R. C. A. Prior read a letter from a correspondent concerning the rare case of a mistletoe parasite on a mistletoe.—Lord Lilford exhibited and remarks were made on a series of skins, skulls, and horns of the Wild Sheep of Cyprus (*Ovis ophion*, Blyth).—Mr. E. M. Holmes pointed out the peculiarities of the Antheridia in an excellent example of *Polysiphonia fastigiata*, gathered at Ventnor.—Mr. F. Crisp exhibited slides prepared at the Zoological Station of Naples, illustrating the early stages of the life of invertebrates, and he also showed living specimens of the new Medusa, *Limnocodium victoria*.—Mr. C. Stewart showed microscopic sections of the growing point of chara and of the common ash.—A paper was read by Mr. F. M. Campbell on certain glands in the maxillæ of spiders. These glands, to which he attributes a secretory function (probably salivary), he finds in *Tegeneria domestica* have apertures on the inner side of the upper face of each maxilla, thence inclining towards the mouth. They are ring-like in figure, with an inclosed disk. There are integumental folds at their outlets. The glands and apertures increase in number with age, and the ducts tend to become chitinous. Glands varying somewhat in structure, but evidently similar in kind, exist in species of Liniyphiidæ, Theridiidæ, and the Epeiridæ.—Mr. S. O. Ridley made a communication on two cases of incorporation by sponges of spicules foreign to them. In a species of the genus *Ciocalypta*, Bwk., the dermis contained spicules which belonged to a species of *Esperia*, and which latter sponge had been obtained in the same haul of the dredge. In another example of *Alebion* spicules also derived from *Esperia* were likewise obtained. Thus an element of error might arise from one sponge containing skeletal structures accidentally derived from a neighbouring sponge of a different genus and habit.—Prof. Allman then called attention to the remarkable Medusa recently observed by Mr. W. Sowerby in the freshwater tank at the Botanic Gardens, Regent's Park (a notice of this appeared in our last week's issue, p. 178).—A short note from Prof. E. Ray Lankester concerning the same Medusa was also read.—Mr. F. M. Campbell read a second paper on the stridulating organs of *Steatoda guttata* and *Linyphia tenebricola*. A stridulating organ has already been described by Profs. Westring and Mason Wood in certain other of the spiders; the present observations demonstrate its existence in both sexes, and the essentials of the structure are given in detail.—Dr. G. E. Dobson, in notes on *Aplysia dactylomela*, a specimen obtained at Bermuda, but not distinguishable from the species inhabiting the Cape Verde Islands, showed that there is inequality of size in the right and left moiety in the dental rows of the lingual ribbon, and he described other structures appertaining to the mandibular plates.—Mr. G. Busk communicated some researches of

his on the Polyzoa collected in the late North Polar Expedition. Several interesting and new forms are given, while the author expressed himself in certain cases as differing in his determinations from Prof. Smitt of Stockholm.—A paper on the natural classification of the Gasteropoda (part 1), by Dr. J. D. Macdonald, was read. He refers to a communication of his published by the Society twenty years ago, wherein sexual characters, lingual dentition, and auditory concretions formed the basis of classification. With modifications this is now elaborated, and in certain groups additional value given to the lingual and labial dentition.—The sixth contribution to the mollusca of the *Challenger* Expedition, by the Rev. R. Boog Watson, was taken as read. The author treats of the Turritellidæ, and describes nine new species.—A paper by Sir J. Lubbock was read, namely, Observations on Ants, Bees, and Wasps, with a Description of a new species of Honey-Ant, an abstract of which appeared last week (p. 184).—The following gentlemen were elected Fellows of the Society:—The Rev. H. G. Bonavia Hunt, Trinity College, London; H. N. Moseley, F.R.S., University of London; the Rev. A. Merle Norman, Durham; and E. A. Webb, Turnham Green.—The President with a few parting words then closed the session.

Chemical Society, June 17.—Prof. H. E. Roscoe, president, in the chair.—The following papers were read:—On pentathionic acid, by T. Takamatsu and Watson Smith. The authors have examined the evidence for and against the existence of this substance; they conclude that it does exist, and give a new method of preparing it, by the action of a very strong solution of iodine in hydriodic acid upon lead theiosulphate.—Preliminary note on some orcinol derivatives, by J. Stenhouse and C. E. Groves. The authors have confirmed their previous conclusion that halogen derivatives of orcinol exist, containing 5 atoms of bromine, &c., both the hydrogen atoms in the hydroxyl groups being displaced.—On the determination of carbon in soils, by R. Warington and W. A. Peake. Oxidation with potassium permanganate gives 92 per cent. of the total carbon, but digestion with chromic acid, &c., only 79 per cent. The best method is combustion with oxide of copper in a stream of oxygen.—Note on camphydrene, by H. E. Armstrong. In this note the author sharply criticises a recent paper by Dr. Letts in the Berlin *Berichte*, and, as a result of some experiments, completely confirms the statement of Montgolfier that the substance formed by the action of sodium on the solid hydrochloride from turpentine oil is a mixture, and not a hydrocarbon having the formula $C_{10}H_{17}$, as asserted by Dr. Letts.—On the action of nitric acid upon diparatolylguanidin, by A. G. Perkin. Dinitrodiparatolylguanidin, melting at 205°, was obtained in red crystals, also, by a slight modification, dinitrodiparatolylurea, melting at 233°.—On some higher oxides of manganese and their hydrates, by V. H. Veley. The oxide was precipitated by chlorine from a pure solution of the acetate, and was then heated in a current of air, oxygen; hydrates, Mn_6O_{11}, $2H_2O$: $2(Mn_6O_{11})3H_2O$, and $Mn_{12}O_{23}H_2O$ were obtained; but in no case was the dioxide formed.—On a new method of preparing dinitroethylic acid, by E. Frankland and C. C. Graham. This consists in passing nitric oxide into a mixture of zinc ethyl and sodium ethyl, to which a suitable solvent such as benzine has been added.—On the action of organo-zinc compounds upon nitriles and their analogues, by E. Frankland and H. K. Tompkins. The action of zinc ethyl upon phenylacetanitrile is studied.—On the action of benzoyl chloride on morphine, by C. R. A. Wright and C. H. Rennie. The end result is always dibenzoyl morphine.—An examination of terpenes for cymene by means of the ultra-violet spectrum, by W. N. Hartley. The author has examined specimens of orange oil, French turpentine, and Russian turpentine, by photographing their absorption spectra; the first two oils were free from cymene, the last contains certainly less than 4 per cent.—Notes on the purple of the ancients, by E. Schunck. The author has examined a sample of the dye still used on the Pacific coasts of Nicaragua, and finds that it contains a colouring matter soluble in boiling anilin, having all the properties of punicin obtained by him from the *Purpura lapillus* of the British coasts.—The Society then adjourned over the summer recess.

Anthropological Institute, June 8.—Major-General A. Pitt-Rivers, F.R.S., vice-president, in the chair.—Mr. F. G. Hilton Price, F.G.S., read a paper on camps on the Malvern Hills. Last September, having obtained permission from Lord Somers to excavate in any part of the camps on these Hills, he set his labourers to work, first on Hollybush Hill, on the south side of the Malvern range, and afterwards on Midsummer Hill, both of which were encircled by a deep ditch and a rampart, while in the glen between the two hills on the south side was the site of a town about 1,100 feet in length. In the interior of the ancient camp on Hollybush Hill were many hut hollows, some of which he opened, but without making any discovery. On the east face of Midsummer Hill were several lines of such hollows, which, like the rest, had been habitations, and no fewer than 214 had been counted. Along the ravines between the two hills were four tanks, having the ancient dams for holding back the water still in existence. The explorations of these camps were not very fruitful. More productive were the excavations on the Herefordshire Beacon Camp, one of the largest and strongest earthworks in the district. It had usually been looked upon as of British origin, and Mr. Price saw no special reason for doubting it. In one hut hollow much coarse black pottery was met with, and there were besides many bones of the ox, pig, horse, sheep, dog, some kind of gallinaceous fowl, and of the deer. A description was given of the huge block of syenite known as the "Divination stone." It was mentioned that in 1650 a jewelled gold crown or bracelet was found in a ditch at the base of the Herefordshire Beacon. Camden had written of it, and in a MS. said to belong to Jesus College, Oxford, it was stated to have been sold to a Gloucester goldsmith for 37*l.*, who sold it to a jeweller in Lombard Street for 250*l.*, who sold the stones alone for 1,500*l.* There were many traditions as to coins found there, but their dates were uncertain. Mr. Price thought this large camp, as well as those on Hollybush and Midsummer Hills, were of late Cymric or Celtic origin, that the latter camp was of earlier date than that on the Herefordshire Beacon, and that in all likelihood they were occupied by the Romano-British, as many remains of those tribes existed in the district, and the pottery seemed to date from that period.—A paper was read on religious beliefs and practices in Melanesia by the Rev. R. H. Codrington. The subject is a very difficult one, inasmuch as, the islands and dialects being so numerous, no one person's knowledge can well range over the whole. The author's information was chiefly derived from the Banks' Islands and the Solomon group, whence the most advanced scholars have come to the Melanesian Mission Station on Norfolk Island. Nothing is known to show that the Banks' Islands have been influenced by Polynesian immigration or neighbourhood; though there are still men alive who can remember a visit of double canoes from Tonga. The Banks' Islanders alone among Melanesians knew no cannibalism and wore no dress. The Banks' Islanders distinctly recognise two orders of intelligent beings different from living men; they believed in the continued existence of men after death in a condition in which they exercised power over the living; and they believed in the existence of beings who were not and never had been human. The latter are called Vuis, and are divided into two great classes, corporeal and incorporeal. The most conspicuous amongst the first class is Qat, the legends concerning whom correspond to those which prevail among the Maories and other Polynesian people concerning Maui or Tangaroa. The brothers of Qat have all of them the name of Tangaroa, and the Vuis of the northern New Hebrides have the same name, which is also applied in Banks' Islands to stones used as fetishes or amulets. The story of Qat's disappearance from the island bears a close resemblance to that of Noah and the Flood, and has possibly been embellished since the Bible history has been made known among the natives. Of the same order of beings with Qat and his brothers, though looked upon as very inferior, are certain Vuis, having rather the nature of fairies. Some of these are called Nopitu, which come invisibly, or possess those with whom they associate themselves. The possessed are themselves called Nopitu. Such persons would lift a cocoa-nut to drink, and native shell-money would run out instead of the juice, and rattle against their teeth; they would vomit up money, or scratch and shake themselves on a mat while money would pour from their fingers. This was often seen, and believed to be the doing of a Nopitu. The story of the bringing of death into the world is remarkable, because it is told without any variation in the Solomon Islands and Banks' Islands alike. At first men never died, but when advanced in life they shed their skins like snakes or crabs, and came out in renewed youth. An old woman went to a stream to change her skin, and let the old one which she had shed float away till it caught against a stick. She then went home, where she had left her child; the child refused to recognise her, and, declaring that she was another

person, could only be pacified by the woman returning for her cast-off integument and putting it on again. From that time mankind have died. The Vuis, which are incorporeal and have nothing like a human life, have a much higher place than Qat and his brothers in the common religious system of the Banks' Islanders. They have no names, no stories are told of them, and they have no shape, but they are numerous, and are present and powerful to assist men who can communicate with them. They are very generally associated with stones, snakes, owls, and sharks. Communication with these Vuis is not in the power of all, but there is an order of priests. If a man has his stone or his snake, by means of which he supposes that he can obtain favours from his Vui, he will instruct his son or some one else to take his place. No other sacrifice than that of the shell money in common use seems to be offered in Banks' Islands. The great institutions of the Banks' Islands are the Suge and the Tamate. Neither has a religious character, nor is any superstitious practice necessarily connected with them. The Suge is a club, the house belonging to which is the most conspicuous building in every village, and is to be found wherever there is a permanent habitation; this house, or "gamal," has many compartments, each with its own oven, in accordance with the several grades in the society. To rise from one grade to another money has to be given and pigs killed. The authority of the men highest in the Suge is very considerable, and it is these persons who appear to traders and naval officers as chiefs. The Tamate is a secret society, to which entrance is obtained by payment, and the neophyte has to spend many days in the Salagoro, or sacred place; the only secret, however, is the making of the masks and hats in which the members appear in public and the way of producing the sound which is supposed to be the cry of the ghosts. The members of the great Tamate indulge in much licence. When they choose to go abroad to collect provisions for one of their feasts, the women and uninitiated are obliged to keep away from their paths. The warning voice of the Tamate is heard, and the country is shut up.

PARIS

Academy of Sciences, June 21.—M. Edm. Becquerel in the chair.—The following papers were read:—On the reduction of pendulum observations to the sea-level, by M. Faye. Some deductions are here made from principles he lately enunciated.—On effects of reversal of photographic images by prolongation of the luminous action, by M. Janssen. After a certain time of exposure a less distinct negative image is had, and with continued exposure this image quite disappears, and a positive one is obtained, which may be quite as distinct as the first. This was the case, *e.g.*, in photographing the sun at Meudon, when plates that had been exposed $\frac{1}{1000}$ of a second, or even $\frac{1}{10000}$ of a second (gelatino-bromide plates) were exposed half a second or a second. The sun's disk appeared white, the spots black. Similarly, positive images of landscapes, &c., were obtained. The same spectral rays give first the negative image, then the positive.—On the heat of formation of oxides of nitrogen and of those of sulphur, by M. Berthelot. The discrepancies of former observations on oxides of sulphur are here accounted for chiefly by a simultaneous formation of several degrees of oxidation of sulphur, and perhaps even the presence of water-vapour. The author's own experiments lead to the result that $S + O_2 = SO_2$ gas liberates + 34·63.—On the luminous spectrum of water, by Dr. Huggins.—Proportion of carbonic acid in the air; reply to M. Marié-Davy, by M. Reiset.—New meteoritic mineral, with a complement of information on the fall of meteorites observed in Iowa, in May, 1879, by Prof. Lawrence Smith. The formula he now gives for the mineral (indicated at the *séance* of April 26, 1880), is $SiR + \frac{1}{2}$ (Si, 2R), or perhaps more exactly $2\ddot{S}iR + \ddot{S}i, 2\dot{R}$, which represents 2 at. of enstatite or bronzite united to 1 at. of olivine. The name of *Peckhamite* is proposed (after Prof. Peckham). On the border of Emmel and Dickson Counties some 3,000 fragments were found within a radius of 13 km.; their total weight 30 kg. Though they had lain nearly a year under water (submerging a prairie), there was not a trace of oxidation. Prof. Smith thinks this may have been due to a thin invisible coating of silicates.—Employment of bitumen of Judæa against diseases of the vine, by M. Schefer.—Report on Mr. Peirce's memoir concerning the constant of gravity at Paris and the corrections required by old determinations of Borda and Biot. The length of the simple pendulum determined by Peirce with his own apparatus is 993·934 mm., alt. 74 m. (Biot 993·913 mm., same alt.; Borda 993·918 mm., alt. 67 m.).—On the problem of inversion, by Mr. Elliot.—On an apparatus for registering the law of motion of a projectile, either in the bore of a gun or in a resistant medium, by M. Sebert. A metallic smoked rod, of square section, is fixed in the axis of the projectile, and serves as guide to a small mass carrying a small tuning-fork furnished with two metallic points, which leave undulating traces on the blackened surface, as the projectile moves along (the prongs of the fork being liberated from a constrained state, and set vibrating, when the motion of the projectile commences). From the tracing may be deduced the velocities acquired and the accelerative force in function of the time; also the law of the pressures developed.—On the transcendants which play an important part in the theory of planetary perturbations, by M. Darboux.—On the method of Cauchy for the development of the perturbative function, by M. Trépied.—On linear differential equations with an independent variable, by M. Appell.—On certain linear differential equations of the second order, by M. Picard.—On elliptic functions, by M. Farkas.—On some modifications in the construction of the Bunsen lamp and of monochromatic lamps, by M. Terquem. There are no lateral apertures, and the air is admitted between the foot of the lamp and the bottom of the tube, which is raised somewhat (6 to 7 mm.). A cross plate divides the orifice into four parts. The temperature is found nearly uniform from the upper point of the flame to the top of the green cones, and from the centre to the circumference. (An analysis of the gases drawn off is given.) This flame is variously superior, and it gives, with sodium, *e.g.*, a much more intense monochromatic flame.—On the flow of gases, by M. Neyreneuf.—On the etherification of bromhydric acid, by M. Villiers. *Inter alia*, the limit of etherification is not equal to that corresponding to organic acids, and it rises with the temperature. Etherification ceases in mixtures containing a certain proportion of water. The limit of dilution from which etherification ceases rises with the temperature.—On the hydrate of iodide of methyl, by M. de Forcrand.—On the artificial reproduction of analcime, by M. de Schulten. The process consists in heating in a closed vessel at 180° to 190°, a solution of silicate of soda or caustic soda in presence of an aluminous glass.—Presence and special character of oyster-marls of Carnetin (Seine-et-Loire), by M. Meunier.—Prevision relative to the amount of current water in the valley of the Seine during summer and autumn of the present year, by M. Lemoine. The Seine between Paris and Rouen, with its large affluents, is expected to present one of those serious and prolonged diminutions of volume which occurred in 1863, 1868, and 1871, but no extraordinary drought.—On the geological constitution of the Isthmus of Panama, with regard to the execution of the inter-oceanic canal, by M. Bouter.

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